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ABSTRACT

This document contains materials for a 10-day teaching unit on solid waste recycling for grades K-6. Included are: (1) "The Scrap Map," which shows recycling cycles for metals and paper, and a cryptic word puzzle; (2) three pamphlets on recycling paper, nonferrous scrap metals, and scrap iron and steel; (3) a list of the chapters of the Institute of Scrap Recycling Industries, Inc.; (4) a booklet of background information; (5) bulletin board materials; and (6) "The Scrap Map Teaching Guide," which contains ideas for ten days of activities, extension activities and a teacher's glossary. (CW)

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# THE SCRAP MAP

AN ENVIRONMENTAL PUBLICATION

FOR GRADES K-6

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*Tell your teacher that a*
*Scrap Map Teacher's Kit*
*is available by writing to:*

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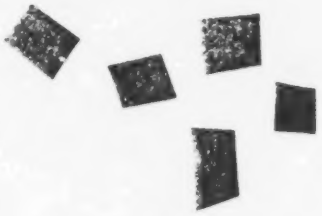
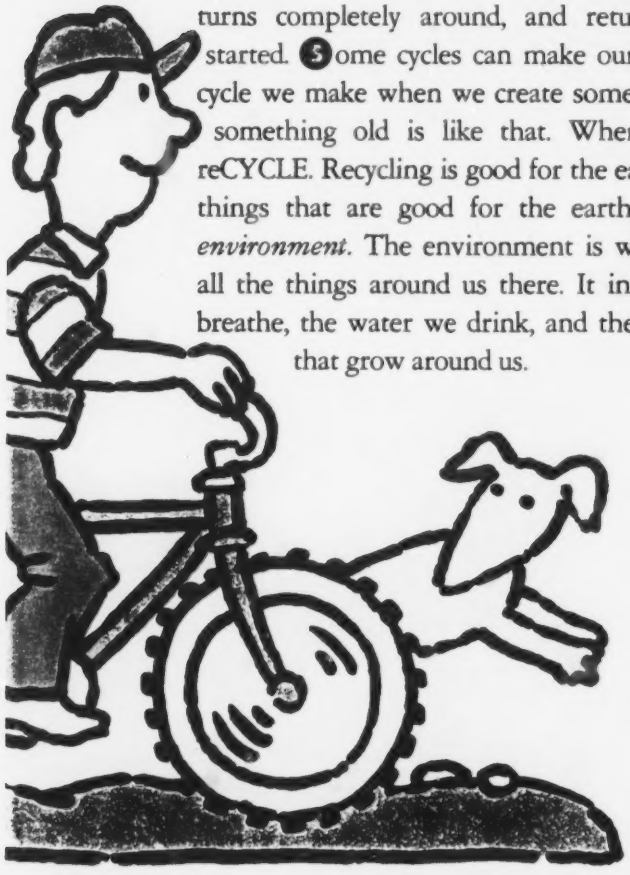
202-466-4050



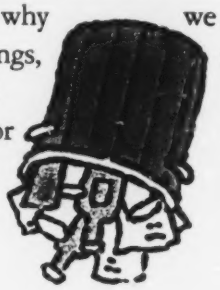
## SOME THINGS GO AROUND IN CIRCLES

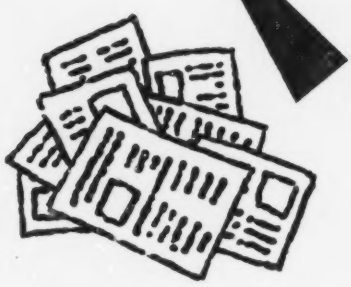
Some things go around in circles, like the tire on your bicycle. When you pedal your bike, the tire turns around ov and over again to give you many rides. When a ci turns completely around, it creates a *cycle*. A cycle starts at one place, turns completely around, and returns to where it started. Some cycles can make our lives better. The cycle we make when we create something new out of something old is like that. When we do this, we reCYCLE. Recycling is good for the earth. When we do things that are good for the earth, we protect the *environment*. The environment is where we live and all the things around us there. It includes the air we breathe, the water we drink, and the plants and trees that grow around us.



## OUR ENVIRONMENT IS IN DANGER

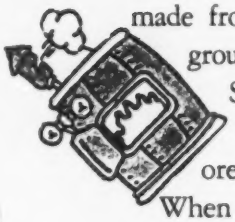
Our environment is in danger. We use many things only once and then throw them away, things like worn-out bikes and cars, empty soda cans and bottles, and old newspapers. We bury them in places called *landfills*. But we are running out of landfills. Soon we may not have any more places to bury these things. When we use old things to make new things, we are recycling. We don't have to bury them in landfills. This is good for the environment. Recycling also saves *energy*. Energy is what makes machines run. Machines need less energy to make new products from recycled ones. So if we don't recycle, we have to use more of the earth's good things, like oil and coal, to make more energy. This is not good for the environment. That's one reason why we must recycle. We must recycle old things, and things that we no longer use, to make new products. This is good for the environment.

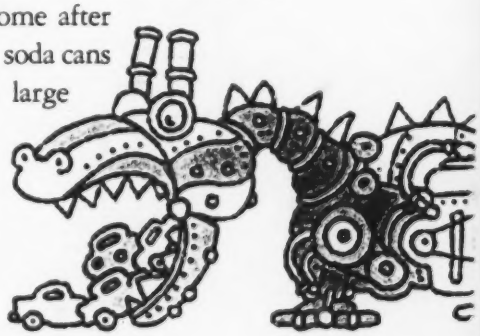




## HOW DOES RECYCLING WORK?

When we recycle, we create a big circle. That circle starts turning around when we decide we no longer want something. Let's see how three things can become part of a recycling circle. They will make a *journey,* or trip, that we can follow on The Scrap Map. When the journey is finished, we will understand how recycling works. We have three different things we don't want any more: a large bag full of empty soda cans, some old cars, and a pile of old newspapers. The empty soda cans are made of *aluminum.* Aluminum is a *metal* product. Metals are made from *mineral ores,* which we dig out of the ground, especially from mountains and mines. Sometimes, if we look closely, we can even see ore in small rocks. Once we dig up mineral ores and use them, they cannot be replaced. When we recycle, we don't need to use more mineral ores. This is important because, if we use too many mineral ores, we might use up all that the earth has. Then there won't be any more to make new metal products for those who will come after us. Recycling can melt empty soda cans instead of mineral ore in a large oven, called a *furnace,* to make new cans. This helps the environment because it





Special words are often used to describe what and how things are recycled. Some of these words are hidden in this puzzle. The words go across, down, and diagonally. Can you find all 18?

C B R E C Y C L E G
L A X M I L L A P S
A L M T R E E S N H
N E A O C A R Q S R
D B M E L O C T C E
F S E N E R G Y R D
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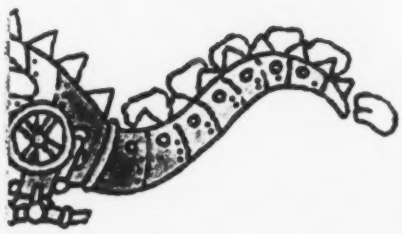



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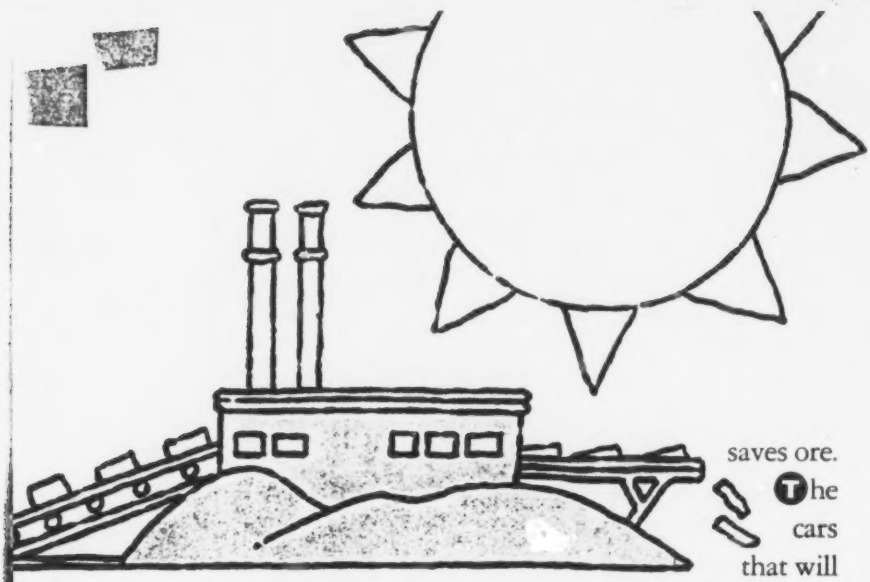
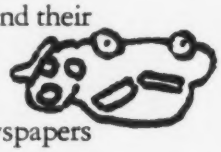
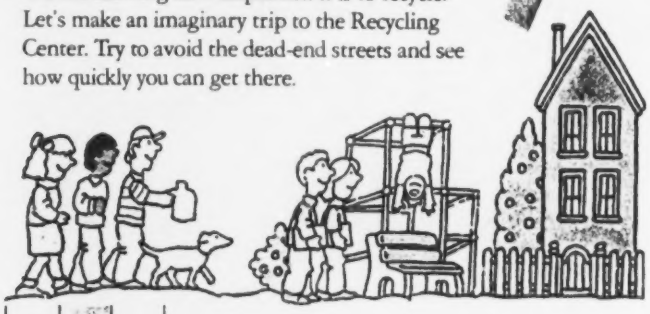
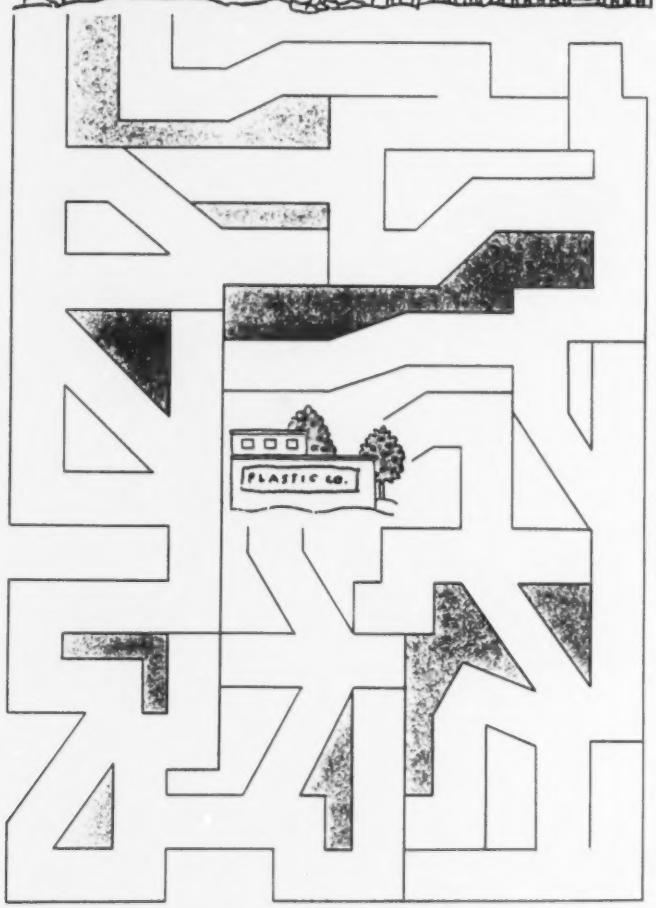


saves ore. The cars that will circle The Scrap Map are also made of metal. They are made from *iron* ore. We can make *steel* from iron ore. Steel is used to make cars, washing machines, refrigerators, trucks, buildings, bridges, and thousands of other things that make our lives better. On The Scrap Map, the steel in these old cars will be recycled, and a new bridge can be built from recycled steel instead of using new iron ore. Every day Americans throw away millions of used newspapers. Like all paper products, newspapers are made from *pulp,* which comes from trees. Trees are good for the environment. They help give us clean air to breathe. Their roots hold soil or dirt in the ground so rain doesn't wash it all away. And their branches and trunks hold back the wind so that other plants, soil, and even houses don't blow away. When we recycle, we can use old newspapers and other kinds of used paper to make new paper products. We don't have to use pulp from trees.



We are learning how important it is to recycle. Let's make an imaginary trip to the Recycling Center. Try to avoid the dead-end streets and see how quickly you can get there.






Turn the page to The Scrap Map and see how we can make new products from old ones that we recycle.

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# The Scrap Map Teaching Guide

Implement all or part of this 10-day teaching program that uses *The Scrap Map* as the basic teaching tool.

## ■ Day 1

Read with your class the opening sections of *The Scrap Map* that explain the circular concept of recycling. Draw a circle on the board and have the children list as many objects as they can that rotate. Using the children's lists as the basis, explain the concept of movement from start to finish, and the repetition of the movement involved, in order to communicate the concept of a cycle. Bring in a wheel, a clothesline pulley (available at hardware stores), a hula hoop, or a phonograph record to illustrate the principle.

## ■ Day 2

Read the section of the brochure that introduces the concept of *environment*. Use the poster photographs of trees, streams, mountains, and mines to illustrate aspects of the environment we need to protect. Explain the notion of endangering the environment by discussing littering, as well as air, water, and soil pollution. Explain what a landfill is in greater detail than the brochure provides.

## ■ Day 3

Read the section of the brochure that introduces the concept of energy, and machinery's and manufacturing's reliance on it. Explain where energy comes from (the various *sources* of energy and how it powers machinery). Explain why it is important to conserve energy sources, especially those that are nonrenewable, such as petroleum and coal.

## ■ Day 4

Bring in a magnet; some steel objects such as scissors, tools, or paper clips, and some nonferrous (no iron content) metal items such as brass keys, candlesticks, or screws; aluminum pots; and copper cooking utensils and pennies. Explain mineral ores and mining for the class. Demonstrate the magnetic property of iron by picking up the steel objects with a magnet and comparing the lack of pull when the magnet is placed near the nonferrous items. It would be especially helpful to try to bring in mineral specimens containing samples of common ores. These are likely to be available in rock samples that you might obtain from your school's science department or your school district's science program. You might also be able to borrow or purchase samples from a nature center or nature store or a museum gift shop.

Also discuss the benefits of forests and trees — how they protect against erosion, emit helpful chemicals into the air, cool the atmosphere, and act as wind barriers.

## ■ Days 5, 6, and 7

Begin *The Scrap Map* journey with the class. Bring in yourself or ask the children to bring in empty soda cans, a toy matchbox car (steel — not plastic) commonly available at toy stores or in the toy departments of drug and variety stores, and some old newspapers. Divide the class into three groups. Using three different colored strips of crepe paper, create the three circles of *The Scrap Map* in the classroom. Place each of the objects at the starting points of the respective circles. Assign each group of children to make examples of some of the equipment and buildings illustrated on each of *The Scrap Map*'s circles by making them out of small boxes, such as cardboard jewelry boxes or wooden match boxes, construction paper, or similar materials. Using the brochure and the illustrated *Scrap Map* itself, each day move the objects along the crepe paper circles, explaining important concepts along the way.

## ■ Day 8

Have your class work on one or more of the games in *The Scrap Map* brochure on the opposite side of the poster.

## ■ Day 9

Invite a scrap recycler or industrial consumer of scrap to your class. Locate one by contacting a regional chapter of the Institute of Scrap Recycling Industries, Inc. (ISRI). A list of chapter contacts is enclosed. Ask the scrap industry representative to bring photographs of recycling activities, as well as samples of scrap, and talk to the children about processing and recycling activities, including the kinds of new products that can be made from scrap materials the company handles.

## ■ Day 10

Look for the scissors at the bottom of *The Scrap Map*. Below that line is a work area you may have the class use to draw and color their own concepts of a recycling circle. When they have completed it, ask them to cut out and tape or glue the circle so they may have a personal recycling circle to keep on their desks.

*(Over)*

## ■ Alternative Activities

For Grades K-2, ask the children to make large posters, each depicting a single object that can be recycled. Display them throughout the corridors of the school. For Grades 3-6, have them write an essay or prepare an oral presentation explaining how they might increase personal or community recycling.

Begin a classroom recycling program. Bring in or make four bins: for metals, paper, plastics, and glass. Explain how your class will use them from now on. Consider planning a field trip for the future where your class might take their collected beverage cans to a recycler, get paid for them, and use the money to purchase something for the classroom.

For additional recycling information, contact ISRI's Public Relations Department. See the address and phone number below.

## ■ Teacher's Glossary

**Bale** — a large bundle of tightly compressed materials, usually secured by wires, cords, or similar binding. Bales constitute an intermediate stage of the recycling process.

**Earth Day** — a national day of observance on which the nation focuses attention on environmental issues and explores ways to protect Planet Earth in the future. Usually held on April 22.

**Energy** — those resources, such as petroleum, coal, gas, wind, nuclear fuel, and sunlight, from which a power source in the form of electricity, heat, and the like can be produced.

**Environment** — the objects, conditions, or influences that surround us in the places where we live and work.

**Landfills** — large spaces of land where we dump trash, then bury it beneath a layer of earth; usually equipped with a liner to reduce soil and water pollution from contaminating seepage, thus the common references to "sanitary landfills."

**Minerals** — natural substances usually composed of inorganic materials having definite chemical structures.

**Ores** — metal-bearing minerals or rock, usually obtained by mining. Steel is derived from iron ore, while aluminum comes from bauxite ore.

**Pulp** — a soft, moist, slightly cohering mass into which certain types of wood trees are converted to make paper. Used papers can also be made into pulp as a substitute for wood in new paper manufacture.

**Scrap** — old, discarded, rejected, or leftover items used, after processing by scrap recyclers, as raw materials for new manufacturing.

**Institute of Scrap Recycling Industries, Inc.**

**1627 K Street, N.W.**
**Washington, DC 20006-1704**
**(202) 466-4050**

*Recycled Paper*

## BULLETIN BOARD IDEAS

We have provided four poster-size photographs that will make the creation of interesting and attractive bulletin boards on recycling easier.

Use your imagination! Create a bulletin board using *only* recycled materials.

- Cut letters out of cardboard from cartons, paper grocery bags, or even newspaper. Make a headline out of styrofoam "peanuts" pinned in place.
- Make a city out of building shapes cut from styrofoam blocks used to pack appliances and electronic equipment. Paint them with poster paint— a few drops of liquid detergent added to the paint will make it adhere better. Be sure to include a recycling center and a scrap processor in your "community".
- Make a giant, three-dimensional scrap cycle. Use the four poster photographs around the outside to show how recycling helps the environment.
- Separating our throw aways is an interesting topic. Make a bulletin board showing what materials can be effectively separated at home for recycling. These include aluminum cans, paper, and plastic. Use clear plastic bags to display materials for recycling.

*Recycled Paper*



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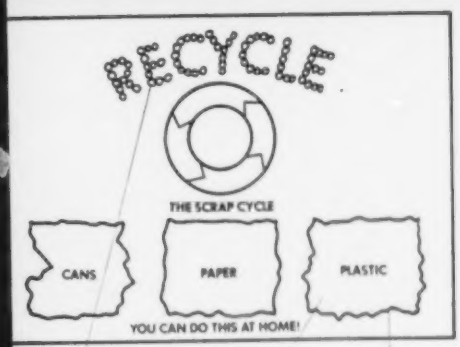
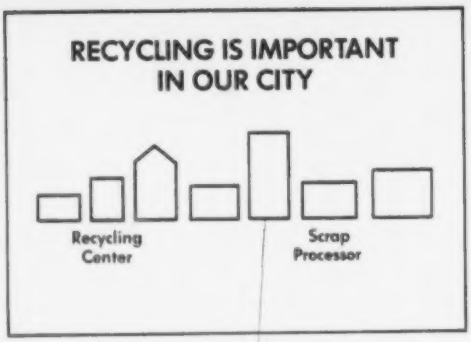


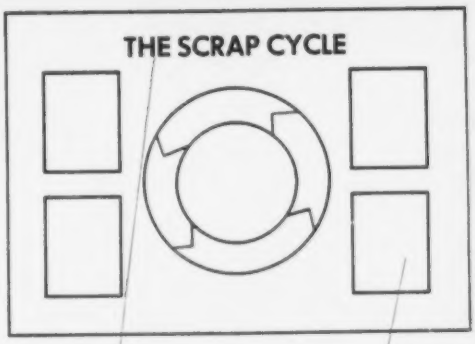

Styrofoam "peanuts"

Recyclable materials

Clear plastic bags




Styrofoam blocks




Cardboard letters

Poster photographs



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# THE SCRAP MAP ORDER FORM

**Complete Teacher's Kit** ..... **$5.00***

Includes one copy of The Scrap Map, environmental poster with bulletin board suggestions, Teacher's Guide, ISRI information brochures on metal and paper recycling, a copy of the booklet *Scrap: America's Ready Resource*, and list of ISRI chapters with contact persons.

**The Scrap Map (Student Copy)**

**Per package of 30** ..... **$15.00***

**Per package of 50** ..... **$25.00***

**Prices for schools, teachers, libraries, and nonprofit organizations, who must attach letterhead or business card to order form). Other nonmembers of ISRI should contact ISRI Public Relations Department for pricing information.*

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Recycled Paper



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# Scrap: America's Ready Resource

**Institute of Scrap Recycling Industries, Inc.**
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# Scrap: America's Ready Resource

Scrap processors and recyclers in the United States are represented by the Institute of Scrap Recycling Industries, Inc. (ISRI), headquartered in Washington, D.C.

More than 1,700 companies are members of the organization. They are processors, brokers, and consumers of scrap commodities — including ferrous and nonferrous metals, paper, glass, textiles, and plastics — and suppliers of equipment and services to the industry.

ISRI was formed in 1987 through a merger of two groups, the Institute of Scrap Iron and Steel and the National Association of Recycling Industries.

Together, the two organizations represented almost 135 years of service to the business of processing and recycling scrap commodities. The National Association of Recycling Industries was founded in 1913 as the National Association of Waste Materials Dealers, Inc. The Institute of Scrap Iron and Steel was founded in 1928.

Largely family-owned businesses, scrap companies have seen the rise and fall of their markets many times, for scrap demand and prices have made the industry one of the most volatile known. As an upward business cycle replaced the economic disaster of the mid-1980s, scrap executives drew on their experience and enthusiastically worked to form the new organization.

In good times and bad, ISRI and its predecessor organizations have maintained comprehensive programs and services for the membership and a broad program of information for the public.

In such diverse areas as insurance, safety, education and training, transportation, government affairs, public relations, and public information, the organization provides its members with a unique array of services designed especially for the scrap processing and recycling industry.

Additionally, through 23 chapters, ISRI members work with state, city, and county government officials as well as community and public service organizations to help plan and carry out programs concerning recycling.

This publication is but one of many services provided by ISRI to explain its membership, its goals, and its common interests with concerned citizens. For further information, please contact ISRI headquarters in Washington, D.C.

## Scrap: America's Ready Resource

Go to almost any city in the United States, even to smaller towns. In an industrial sector on the outskirts, or frequently in the heart of the city, probably near a major highway or railroad siding, look for the tall fencing along the street boundaries, the giant equipment in the background, trucks entering and exiting the gateway.

The sign may read Allen or Jacobs or J&J, then Iron and Steel Scrap, or Scrap Paper, or Scrap Metals, or Salvage, or Smelting, or Refining.

Chances are you have come upon a representative part of the American scrap processing and recycling industry, perhaps a smaller, family-owned company operating its own facility.

Or the scrap company might not be small at all — it may be a large national or even international organization, engaged not only in scrap processing, but also in other commerce.

The scrap product the company handles may be iron and steel, nonferrous metals such as copper and aluminum, precious metals including not only gold and silver but platinum and palladium, too, or paper or glass or textiles or any of a number of other reusable commodities, or very likely a combination of some or all of these products.

For more than a century, the plant you see and thousands more like it have worked quietly and efficiently, little known in their communities but well known to those who understand and appreciate the complete cycle of recycling.

The plant may have been started scores of years ago by an immigrant peddler working from a horse-drawn cart, but today it is part of a multimillion dollar business in the forefront of America's concern for a healthy and safe environmental climate.

As you view this plant site, you might well ask yourself a logical and simple question: What would happen if all this was not happening?

The answer is equally logical and simple. If the scrap processing and recycling industry did not exist, our streets and highways and byways would be jammed with abandoned automobile and truck carcasses, our factory doors all but impassable because of the mounds of unwanted materials, our households inundated with broken appliances, and our network of landfills nonexistent, for those dumping sites would long ago have reached their capacity and been forever closed.

Fortunately, the picture is not so dark — for we do have an existing, efficient, competitive scrap processing and recycling industry that operates in what may well be one of the purest supply-and-demand markets at work in the world economy today.

In the United States alone, scrap processors handle in one year approximately:

- 60 million tons of scrap iron and steel
- 1.8 million tons of scrap copper
- 3 million tons of scrap aluminum
- 1 million tons of scrap lead
- 250,000 tons of scrap zinc
- 700,000 tons of stainless steel scrap
- 27 million tons of scrap paper.

The scrap recycling industry is thus a vital element in economic and environmental life in the United States — in fact, in all nations in the world.

As our civilization has grown and prospered, we have left in the wake of our economic success two basic environmental problems.

First, we cannot always dispose of, safely and soundly, many of the goods we manufacture, use, and replace.

Second, we remove from the earth huge volumes of materials — ores, for example, for steel-making, trees for paper pulp. Not only do we deplete these and other resources, but many times we harm our air, water, and land as we do so. And, despite lessons of recent years, we misuse and waste energy.

How, then, can we continue to grow economically without hurting ourselves environmentally? A large part of the answer will be found in the enlarged use of our recyclable scrap materials — our mines above ground, our endless man-made resources of scrap metal, paper, glass, textiles, plastics, and all the other throwaways of our busy and wasteful society.

Truly, we have little or no choice. As available landfill space grows smaller and smaller, as old landfills are closed, as limits are placed on the use of incinerators, there is increasing awareness that scrap recycling is not only a vital part of the solution to our national solid waste problem, but, in combination with environmentally sound disposal practices, is the only choice that makes sense.

There exists in the United States the largest and most advanced scrap recycling industry in the world. Little noticed until recent years, the industry has for decades quietly provided desired goods and valuable services, just as any other manufacturer. Now those goods — recyclable and recycled scrap materials — and those services — collection, processing, and consumption of the materials — must be better utilized if we are to avoid overflowing our city streets and our country meadows, our rivers and lakes, with the harmful and wasteful residue of our way of life.

The nation's scrap recycling industry stands ready to do more than its share in helping resolve what is quickly becoming a national and international crisis. The use of scrap helped the United States win world wars. Now scrap recycling can help win the battle for a livable, prosperous nation and world.

## How the Scrap Industry Works

### ■ The Scrap Cycle

Steel or paper, gold or glass, all recyclable products have a common story. From their first beginnings in mines or oil fields, forests or farms, through processing, manufacturing, and use, eventually all come to be scrap. And for many commodities, the cycle is not complete with just one trip around, for there is virtually no limit on the number of times metal, fiber, or glass can be reused.

Iron, steel, copper, lead, aluminum, zinc, nickel, gold, and silver, and their many alloys become "mines above ground" when discards are reused. Recycled paper and textiles become substitute farms. Worn-out products can have value long after they have served their original purposes.

### ■ What is Scrap?

Old automobiles, farm equipment, ships, refrigerators, stoves, buildings and bridges, batteries, airplanes, computers, newspapers, packaging materials, worn-out fabrics — all these are or contain scrap. Scrap is also the materials that are left over when new metals are processed and new products are manufactured. It can come from a steel mill, a wrecking ball, or your house.

### ■ The Scrap Processor

It is the scrap processor's job to collect, sort, process, and sell these things to the consuming industries. Most processors tend to be specialized — handling ferrous or nonferrous metals, paper or textiles, precious metals, glass, or plastics, because all require different collection strategies, handling, and markets. What all have in common, however, is a large capital investment in plant and equipment. A single scrap metal processor, for example, has invested in machinery costing from hundreds of thousands to millions of dollars each.

By definition, a scrap metal processor is one who, from a fixed location, utilizes machinery and equipment for processing and manufacturing iron, steel, or nonferrous metallic scrap into prepared grades and whose principal product is ferrous and/or nonferrous metallic scrap for melting purposes.

### ■ The Ferrous Metal Processor

Operating at full capability, the U.S. scrap industry has the equipment capacity to process 140 million tons of iron and steel discards annually, and even on a single-shift basis, 70 million tons of scrap a year can be shredded, sheared, baled, crushed, briquetted, broken, and torched.

This huge capacity underscores the need to increase demand for the products of the scrap processor because domestic and foreign steel mills annually purchase far less scrap metal than can be processed.

The scrap processing industry is now a high-volume, capital-intensive operation, a far cry from its horse-and-wagon beginnings.

A scrap metal processing plant will usually have invested in several pieces of large equipment, depending on the type and volume of scrap available and the needs of its consumers. The typical piece of equipment to the industry is the crane. Most plants will have a hydraulic baling press, an alligator shear or hydraulic guillotine shear—and possibly more than one of each.

Fewer in number are the giant shredders, which can turn an abandoned auto into fist-sized pieces of scrap in less than a minute. But this power comes at a high price: a small shredder, installed and ready to run, costs just over $1 million. The investment for a large unit can run more than $5 million. And that is just the initial cost. A medium-size shredder uses 36 hammers, weighing 250 pounds each, to pound auto hulks to pieces. After demolishing 6,000 cars, the hammers must all be replaced, at a cost of about $20,000. Replacement of other parts could exceed $100,000 a year.

Other equipment found in scrap processing plants might include scales, turnings crushers, briquetters, motor block crushers, conveyors, and the truck fleets and containers necessary to keep the scrap moving from originator to consumer. The scrap metal processor is an important manufacturer of the raw material for industry, and the scrap processing plant is truly a factory without a roof.

### ■ The Nonferrous Metal Processor

The processors of nonferrous metals operate in some ways as ferrous scrap processors, buying scrap from manufacturers, outmoded equipment from railroads, airlines, and other industries, demolishers of buildings and bridges, and other sources. They also buy scrap from other processors who have separated the iron and steel from automobiles and other items and are not equipped or do not desire to handle the nonferrous materials.

The recycling of aluminum, copper, zinc, lead, stainless steel, and precious metals furnishes a high percentage of industry's raw stocks of these materials at a significant savings in energy. Almost half the lead used comes from recycling, for example, and recycled lead saves more than 60 percent of the energy that would be required to process lead from ore.

In the case of aluminum, the energy savings are even more dramatic: recycling saves 96 percent of the energy used to process bauxite and aluminum. Recycled aluminum currently provides about one quarter of the aluminum used in the United States each year. Some 40 percent of the copper used every year is from recycling, at an energy savings of 87 percent.

Depending on the needs of the industrial consumer, the processor of nonferrous scrap supplies either prepared metal, ingots, or pigs for remelting.

### ■ The Precious Metals Processor

It has been said that all the gold ever mined is still in existence. If so, it is a high tribute to the skill of the recycler. The reuse of precious metals was probably one of the earliest forms of recycling because things so precious in and of themselves could not just be thrown away when styles changed or when damaged.

Thirty-five percent of all the gold and about one quarter of the silver used every year comes not from mines but from the scrap plant. Electronic scrap contains a number of precious metals, including gold, silver, and platinum. Gold can be found in space satellites, and silver in switches and photographic supplies. Platinum comes from catalytic converters in automobiles.

### ■ The Scrap Paper Processor

Although the community newspaper drive may be the most obvious source of recycled paper in most people's minds, it is only a very small part of the total. In fact, three-quarters of the scrap paper recycled comes from discarded corrugated and paperboard packaging. The rest comes from manufacturing and converting plants, tabulating cards, discarded office and printing paper, newspapers, and other mixed papers. It is estimated that almost half of all collected (but not necessarily recycled) municipal waste is paper and paperboard.

It is the job of the scrap paper processor to gather this ocean of paper into the processing facility where the usable material can be separated from contaminants. Then the paper must be sorted, graded, and baled for shipment to the paper mill or other end consumer.

There, after being converted to fiber, cleaned, screened, and drained, it is formed into new sheets, ready for use in boxes, containers and paperboard packaging, newsprint, stationery and books, towels, tissues, napkins, and sanitary products.

Recycled paper makes up about 25 percent of the raw fibers used in the paper industry, and recycled fibers can be produced with 70 percent less energy than new.

### ■ The Textile Dealer and Garnetter

In many ways, the textile recycling process is similar to that of scrap paper. The textile dealer buys cotton, wool, synthetic, and synthetic blend textiles from apparel and home furnishing manufacturers, textile mills, and American consumers.

After sorting for type, the processor cuts, washes, and packages the materials for sale to a textile garnetter. The garnetter's operation further sorts the material and then begins the shredding and combing process that produces fibers ready for sale to the textile manufacturers.

Recycled textile fibers can be found in newly made apparel, blankets and carpeting, batting and packaging, fine paper and currency, flock and filler, roofing and flooring, vulcanized materials, and wiping cloths.

About 13 percent of all textile fibers used are on a repeat trip through the mill.

### ■ The Glass Processor

Glass recycling occurs in two different forms. Glass is recycled by its original processor and at the community level where bottles are returned to the store or other collection point by the end consumer.

Recycling by the original processor is the same idea as the home scrap of the metals industry. This material never leaves the works and is easy to reprocess — it is just ground up and remelted in the appropriate furnace. The manufacturer has to do little sorting or testing, because the content of each individual piece is known in advance.

Glass containers are crushed into "cullet." Cullet melts at a lower temperature than the raw materials used to make glass, so manufacturing firms save on energy as well as the costs of sand, soda ash, and limestone.

### ■ The Plastics Processor

The recycling of plastics is in its infancy, but then, so is the plastics industry as a whole when compared to iron or gold. Plastic packaging makes up nearly 4 percent of the municipal solid waste stream, and its quantity is increasing.

Many plastic manufacturers have been recycling their own scrap materials for years, and there is demand for plastic scrap in nations where there is a shortage of new resins.

The problem in recycling plastics is separating materials made from different resins. One clear plastic may look very much like another, yet be composed of very different ingredients. If a processor is buying scrap from a plastic manufacturer, the composition is known. However, in order to mine the waste supplies of municipalities and other sources, segregating by raw materials becomes a major problem.

Much of the research in the plastics industry now centers on ways to use mixed, or commingled, plastics. Plastics researchers are also investigating the potential of recycled plastic as a fuel.

### ■ The Scrap Buyer

The most important component of the scrap processing cycle is the consumer — the industry that buys the scrap processor's product and starts it back on its way through the manufacturing chain. Without that demand, there would be no purpose to the purchase of recyclable materials and no point in separating out the components by material. And it is on the demand side that the equation of the industry is weakest.

As we have already seen, scrap processors have the capability of producing much more material than industry now demands. Despite the side benefits of recycling — a more beautiful environment, reduced waste disposal problems, and energy conservation, processors cannot stay in business if they cannot sell the processed scrap to an end user. There is little use for metallic scrap, for example, beyond the furnace of a steel mill, foundry, smelter, or refiner.

The market for scrap is highly volatile. Prediction of prices for any given scrap commodity at any given time stumps the experts. Ferrous scrap worth $100 a ton in November can be worth $50 two years later and $130 the next year.

The scrap market works the reverse of the traditional market place where the seller sets the price. Here the buyer has the controlling voice. When industry needs more scrap, it offers a marginally higher price; when that price has been successful in generating the scrap supplies they need and more, they lower the price, until the suppliers have no further incentive to collect and process those large volumes of scrap.

Domestically, the ferrous scrap industry, for example, operates on a 30-day lead time: producers announce their needs and the prices they are willing to pay and set delivery for a month. On the export market, for obvious reasons, the lead time is usually longer, 60 days or more.

So the scrap industry operates in an arena where its activity depends not on how much material American industry and American consumers are throwing away, but on how much they are buying: for it is the new purchases that demand the raw materials the scrap processors are set up to produce.

## Types of Scrap

Scrap materials are usually divided into ferrous, or iron and steel; nonferrous, including precious metals; paper; glass; textiles; and plastics. Here are brief descriptions of the major categories.

### ■ Ferrous Scrap

Ferrous scrap is scrap iron and steel — scrap recovered from old automobiles, farm equipment, household appliances, steel beams, railroad tracks, ships, and everything else made from iron or steel.

Ferrous scrap is divided into two categories: home and purchased scrap. Home scrap is the scrap that is generated by steel mills and foundries. With few exceptions, home scrap does not leave the plant, but is returned to the furnace on site and melted again. Home scrap accounts for approximately one-third of the total ferrous scrap used annually.

Purchased scrap is divided into two further categories: industrial and obsolete scrap. Industrial scrap — also called prompt or new scrap — is generated by the metalworking industries. For example, when a piece of metal is cut or a hole drilled, the metal that is left over is industrial scrap. The automotive industry is the largest single source of this category of scrap. Of the total amount of ferrous scrap used annually, about one-fifth is prompt industrial scrap.

Although the scrap processor generally pays the manufacturing firm for industrial scrap, the processor also performs an important service — arranging for removal of the material from the plant. The processor usually provides containers at the plant site that are removed and replaced when loaded. To service an industrial account requires a major capital expense for containers and vehicles to transport the scrap.

There have been times when the demand for certain lower-quality grades of industrial scrap such as borings and turnings was so low that no reasonable market existed. In such situations, scrap processors have been forced to charge the generating firm to transport the material for recycling. Although this might appear strange, the charge is less than the cost of disposal, and recycling occurs that would otherwise not be possible.

Obsolete scrap, also called old scrap, is composed of worn-out, unused and unwanted metal — automobile hulks, old farm tools, stoves, refrigerators, washers and dryers — all of the iron- and steel-containing products we throw away. Obsolete scrap accounts for approximately 40 percent of total ferrous scrap used annually.

The scrap processor buys this raw material and segregates and prepares it into specified grades of scrap that consumers — steel mills and foundries — buy for melting. Ferrous scrap alone has almost 80 grades; additionally, there are another 40 grades of railroad ferrous scrap and many additional grades of alloy scrap.

Obsolete ferrous scrap by far constitutes the main ingredient in our huge nationwide backlog of scrap. Continuing economic studies of scrap supply are conducted regularly; these studies count more than 800 million tons of obsolete scrap in the United States awaiting recycling — recyclable but not yet recycled: more than 800 million tons awaiting a market!

### ■ Nonferrous Scrap

Nonferrous scrap is scrap metal other than iron and steel: aluminum, copper, lead, zinc, nickel, titanium, cobalt, chromium, and precious metals.

Millions of tons of nonferrous scrap metals are recovered annually by processors and consumed by secondary smelters, refiners, ingot makers, fabricators, foundries, and other industries in the United States.

The nomenclature for purchased nonferrous scrap categories is similar to that for ferrous scrap — divided into home, industrial, and obsolete. (Unlike ferrous scrap, however, nonferrous home scrap — that which does not leave the plant — is less significant.) Obsolete scrap is the discarded, dismantled, worn-out metallic elements such as a radiator removed from a wrecked automobile or pipe taken from an old building. From the radiator comes lead, from the pipe copper. Aluminum is recovered from soft drink containers, platinum from automobile catalytic converters, nickel from stainless steel appliances, and silver from spent photographic film.

New or industrial nonferrous scrap is, like new ferrous scrap, metal that has never been made into or used as an end product. Coming from industrial sources as the by-product of the manufacturing process, new scrap can be the aluminum skeleton remaining after can lids are punched out of aluminum sheets, or brass punchings from a screen manufacturer, or copper scrap from manufacturing coinage.

Nonferrous scrap, although not as large in volume as ferrous scrap, is more valuable by the pound and includes not only the more common types of metal such as copper or aluminum, but also exotic space age metals such as titanium and zirconium, tungsten and beryllium, and precious metals — gold, silver, and platinum. As scientific and industrial use of such metals increases, so does the recovery of the metals.

## ■ Scrap Paper

Of all paper available for recycling, scrap paper is perhaps the most commonplace and voluminous in homes, offices, and plants.

The use of paper products in the United States is at startlingly high levels. By far the world's greatest consumers of paper and paperboard products, Americans use about 400 pounds annually on a per capita basis. By comparison, residents of the Soviet Union consume 25 pounds, and residents of China only 2 pounds a year.

Recycled scrap paper accounted for more than an estimated 25 percent of all raw material fiber used by U.S. pulp, paper, and paperboard mills. Approximately 77 million net tons of paper and paperboard were manufactured in the United States in 1989.

During 1989, some 21 million tons of scrap paper were actually consumed by domestic mills and manufacturers, and about 6 million tons were exported.

Of 600 pulp, paper, and paperboard mills in the United States, about 200 use recycled paper almost exclusively, and another 300 use up to 25 percent recycled fiber.

Generally, the recycling rates of paper and paper products, although varying by category, average 25 percent or more. The newspaper industry in the United States reports that more than 4 million tons of old newspapers were collected in 1989 and recycled at a rate in excess of 30 percent.

Other nations, however, have far higher recycling rates. In Japan, for example, as much as 80 percent of all newspapers are recycled.

Products made from recycled scrap paper include:

*Corrugated Products* — Boxes and special packagings used as containers for a variety of goods, including home appliances, furnishings, office equipment, and numerous other products. These strong and serviceable containers are often made of 100 percent recycled materials.

*Construction Materials* — Insulation, roofing paper, padding, siding, flooring, wallboard, and other building materials.

*Towels and Tissues* — Napkins, paper towels, toilet and facial tissues, paper diapers, and other sanitary products.

*Papers for Home and Office Use* — Stationery, printing, mimeo, and copying paper; decorative and wrapping materials.

*Paperboard* — Accounting for the greatest volume of recycled scrap paper, paperboard is used for packaging where structural strength is an important physical property. Paperboard is divided into three main categories: containerboard, used for corrugated and solid fiber boxes; bleached paperboard, for conversion into packages such as milk cartons, frozen food cartons, and containers for foods; and recycled paperboard, used to make folding cartons and other packaging.

*Newsprint* — A growing category of scrap paper usage, newsprint is increasingly being recycled.

## ■ Glass

Recycling of glass — primarily of glass containers — is rapidly becoming an integral part of the glass production industry.

Manufacturers buy back glass, whole and broken, to make new glass products used as containers for food, beer, wine, soft drinks, toiletries, perfume, cosmetics, medicine, and other consumer and industrial items.

The glass recycling process begins with the collection of used bottles and other containers by consumers. The glass is generally first separated by color — usually clear, green, and amber — and cleaned.

The glass containers are then crushed into small pieces called cullet. The glass is used by glass manufacturing plants that mix the cullet with melted sand, soda ash, and limestone to produce new glass containers.

Glass manufacturers use as much as 20 percent cullet in their plants, and the industry is working to introduce more cullet into its container-making process. The energy savings and environmental benefits derived from glass recycling ensure an increase in this trend.

## ■ Textiles

The textile recycling industry processes billions of pounds of cotton, wool, synthetic, and synthetic-blend scrap products. These used products come from a number of sources, ranging from apparel and home furnishing manufacturers to textile mills and American consumers.

The textile fibers are processed and then reused in the manufacture of widely diversified products and materials. Bleached denim and pure cotton scrap, for example, go into making some of the finest stationery and document paper, including U.S. currency.

Recycled cotton and synthetics are ground to produce compounds for manufacturing vulcanized fibers, roofing, and flooring products. Wiping cloths and other useful materials are made from recycled cotton cloth.

Natural and synthetic scrap textiles are used in making flock and filler and in plastic materials that require additional tensile strength. These scrap materials are also used in batting and padding, for toys, upholstery, and cushioning products.

Recycled wool and other textiles are shipped to manufacturers, both in the United States and abroad, for reweaving into new fibers and fabrics. These recycled materials then are made into clothing, blankets, carpeting, and hundreds of other consumer products.

## ■ Plastics

Although recycling of plastic is the least accomplished of significant scrap categories in the United States, experts agree that plastics recycling is beginning to flourish and that by the year 2000 as much as 40 percent or more of all scrap plastic will be recovered and reused, compared to an estimated 1 percent in the 1980s.

Plastics currently are believed to be consumed at an annual rate of about 14 billion pounds in the United States, with most destined for incinerators or landfills after use.

By the early 1990s, however, it is estimated that as much as 5.5 billion pounds might be recovered and reused, rising to almost 11 billion pounds in 1997 and to 14 billion pounds or more by 2002.

Plastics are extremely widely used in contemporary American society, especially in containers, where they compete with glass, metal, and paper. Difficulty in disposing of plastics, however, coupled with overflowing landfills, has spurred research and development into efficient recycling, along with the possibility of degradable plastics. In the near future, industry leaders believe, degradable plastics will be used in products such as disposable diapers and related items, and some packaging — thus addressing some of the problem while recycling addresses the other facet.

## History

The reuse of scrap — metals, paper, glass, textiles — dates back thousands of years, probably to 3000 B.C. or earlier when the age of iron making began. Metal makers found they could reuse the surplus material that was left over in their manufacturing process or was reclaimed from obsolete objects. Similarly, paper, glass, and other products date to early beginnings, for man then perceived he could not afford to be as wasteful as he is today.

Throughout the 50 centuries since iron making's birth, men have been salvaging obsolete metals for melting and for almost half that time have been finding uses for scrap paper and textiles.

Plunderers along the Mediterranean coast are said to have dismantled the giant statue, the Colossus of Rhodes, selling it to weapons makers for melting.

The craft of paper recycling dates back to the period immediately following the creation of the first paper in China in A.D. 105.

Centuries later, Geoffrey Chaucer, known for his *Canterbury Tales*, was employed as Clerk of the Works at Westminster Palace where he was responsible for the collection and inventory of scrap metal. Even the infamous Captain Kidd dealt with metals other than gold and silver. At the time of his capture in 1699, his ship was carrying 10 tons of scrap iron in the form of "wagon tyres" for use in colonial iron works.

Scrap use had come to North America in 1642 when the first iron furnace was built in Saugus, Massachusetts. The nation's earliest paper manufacturers relied on cotton fiber derived from textile rags and from scrap paper made from the same material.

The founding fathers of the United States — including such men as George Washington and Paul Revere — knew the value of scrap. Paul Revere, the silversmith, advertised for scrap metal of all kinds. George Washington urged the use of old worn chain from frigates. Benjamin Franklin's early printings are believed to have included reconstituted scrap paper. Glass shards from the period have indicated reuse of broken glass containers.

Scrap use has been best known throughout U.S. history during periods of wartime, although there have been few if any times when a scrap market in most commodities did not exist.

Collections of metal in particular, but also of paper, cloth, and other used items, date to the days of the American Revolution. Women of the colonies gave their iron kettles and pots to be melted down for armaments. Such use continued to the days of the Civil War, when both North and South urged citizens to donate scrap objects. Metals were in critical need; newpsrint was so rare that, in the South, war reports were printed on almost anything that would fit the presses, including used posterboard.

During the mid-1800s, all aspects of the scrap industry began to change as the United States altered its methods of production in response to the Industrial Revolution. As the iron and steel industry grew, so did the manufacture of various types of paper, glassware, and textiles. A growing demand for quality products forced manufacturers to become increasingly sophisticated, and it was not long before changes in mechanization, in collection, in transportation, and in processing all arrived and spurred rapid industrial growth.

The growth had two effects on the development of the scrap industry. In the metals industry, for example, increased demand for scrap made it more economically feasible for scrap collectors to provide obsolete metal to mills and foundries. Simultaneously, the widespread distribution of manufactured items — from iron and steel, other metals, from paper and glass and textiles — greatly increased the available supply of scrap materials.

Just as supply and demand today rules the scrap business, so did those basic factors in the mid-19th century. One result was a large expansion of the peddler trade.

The era of the peddler, that emblem of early American entrepreneurism, had begun in the earliest colonial days when men with backpacks and horse-drawn carts would journey throughout towns and cities and into the countryside searching for worn-out implements, even rags and bones — anything that had resale value.

It was the peddler who first began the business of providing scrap to manufacturers, including mills and foundries. Many of today's large scrap companies thus trace their ancestry back to the days of the backpack and the horse-drawn cart, with the peddler often being a direct ancestor of today's business families.

As scrap dealers and processors grew in number, their roles were more clearly defined.

In those early days, however, there was no clear division between collector and processor. In time, however, many collectors were to realize that by preparing scrap to make it more appropriate and fitting for use by manufacturing plants and mills, they could increase the value of their products.

It was also during this transition period that collectors and dealers started buying scrap from fabricators themselves — from metalmaking companies, for example — and then processed and found buyers for the "prepared" scrap.

These scrap men also were quick to recognize such concepts as quality control and particularly the need for density, using their equipment to shape scrap sized to the small furnaces then in use.

As dealers and processors grew in number and manufacturers bought from more than one seller, standardization was introduced to ensure that when a contract was made, both parties were talking about the same commodity.

As far back as 1865, newspapers reported on the price and availability of various types of scrap. *The Commercial Bulletin of Boston* wrote in 1876: "Old iron sells steadily at the current rates of $1.30 to $1.40 delivered, but the supply is very small, and though dealers here and there hedge for a 5 cent advance, the consuming buyers even at these prices are few and at that, very indifferent as to whether they purchase or not."

An 1866 publication from the American Iron and Steel Association reported that Civil War battlefield scrap was available in the form of "300 tons shot and cleaned shell to arrive, at $47." The classification of this scrap became even more exacting when later reports identified the battlefield metal as either "Rebel shot" or "Northern shot."

Then, as the Industrial Revolution took hold in the United States, smaller revolutions in individual industries also occurred. Paper production increased after the Civil War, for example, as did the manufacture of glass and textiles. In scrap iron, the advent of the open hearth furnace for steel making, with its much larger use of scrap than the predecessor Bessemer process, resulted in the start of a dramatic rise in scrap demand. The modern scrap industry for iron and steel had been born, and others were to follow.

The history and origins of the scrap business were closely tied to the individualists who entered the business during this growth period. Handling scrap, whether metal or paper or glass or textile, was an unglamorous, demanding, low-profit business. Few people wished to invest their lives and careers in such risky undertakings, and those who did found they needed persistence, hard work, and at times simply a bit of good luck.

The scrap industry might never have developed during this period without the large number of immigrants who came to the United States seeking refuge from tyrannical regimes in their homelands. Most arrived with little or no money and, although they might previously have worked in such professions as law or accounting, they were without training in basic skills necessary in their new environment. Overcoming language barriers and many other difficulties, however, many of these newcomers learned the scrap business — and helped create it in America — by spending years as collectors and peddlers themselves.

The early scrap processors had little, if any, equipment to help them in the arduous task of preparing scrap. In handling scrap metals, for instance, chisels and sledge hammers were used to break apart the large metal objects. Even basic weather was to play a key role — freezing water was used by early workers who would pour water into the cracks of cast iron and steel and then wait for freezing water to break the metal apart.

Hard labor was required to beat and clean rags and paper before the paper-making process could begin.

As the century turned, however, innovative new methods of handling scrap were in place and more were on the way. Shears, balers, torches, crushers, machinery to clean and machinery to screen — improvements in scrap processing became increasingly important as the industry modernized and grew to the beginnings of its present capital-intensive structure.

With the cost of the new equipment being high, even by today's standards, scrap processors had to gamble that the new demand levels for their recycled goods could be sustained long enough to recover their large capital outlays.

To some, the period of high demand in the first decades of the 20th century lasted long enough to recoup their investment; others, however, were crushed by economic losses.

By the time the nation — and the scrap industries — had suffered through the Great Depression, world war was again at hand. Scrap played a vital role in preparing America for war and in sustaining wartime production.

It was during World War II that one canard developed, however, a false tale that was to be repeated time and again about scrap metals. The rumor was that scrap had been shipped to the enemy — Japan — and had come back in the form of bullets aimed at American fighting men.

The facts were that scrap iron and steel, along with aviation fuel, cotton, steel, machinery, and numerous other items had been exported to Japan in the course of normal, peacetime, pre-war trade. All such commerce took place in the light of day with not only the blessing but the encouragement of the United States government, then as now, interested in promoting international commerce.

On October 15, 1940, the U.S. government stopped issuing licenses for the movement of iron and steel scrap to any nation outside the Western Hemisphere except for Great Britain.

No scrap was shipped to Japan after that date, and not a single pound of scrap was ever shipped to Japan or exported anywhere else contrary to U.S. government policy.

Although the scrap industry played a key role in supplying materials for the war effort, repeatedly earning praise of national leaders, this unfortunate myth of scrap-to-the-enemy still persists in some quarters.

The years after World War II, before and after the Korean and Vietnam wars in particular, demonstrated dramatically how scrap demand — the ultimate key to the health of the industry — could be so volatile and unreliable that few if any other industries could survive in such economic conditions.

Scrap metals are particularly responsive to the laws of supply and demand. In the early 1960s, for example, a change in steelmaking methods forced the scrap market for iron and steel down sharply. Mills had introduced the basic oxygen furnace which, unlike the predominant open hearth furnaces employing 50 percent or more scrap in the melting process, used only a small percentage of scrap iron and steel. The scrap it did use was mainly home scrap, scrap generated in the mill itself during the manufacture of new steel.

Another important phase in the evolution of the scrap metal industry came when mounting numbers of abandoned automobiles on the streets and roads of the United States began to create a scenic and environmental blight. Nearly every community in the nation, as well as the federal government, became concerned.

The introduction of giant automobile shredders, however, helped solve the problem. These shredders, which could turn auto hulks into fragmentized scrap in a matter of seconds, required large investments of capital, were expensive to install and maintain, but quickly became the behemoth of the industry. Systems were also developed to separate ferrous from nonferrous metals, but at increasingly high costs to scrap processors.

The scrap utilization picture also saw increased use of the electric furnace in steel making. Although electric furnaces were first used in the early years of the century, it was the post-World War II period that saw them begin to increase in number to meet the growing needs for all forms of steel created by a burgeoning American industry.

Similar advances were marked in other areas of the scrap processing and recycling industries, as new and innovative methods were developed for the handling of paper, glass, and textiles. Plastics had also become a large source of waste materials, at once a problem for the present and a promise for the future.

Thus today's scrap industry has grown — from its beginnings of backpacks, on horsedrawn carts and in wheelbarrows — into a vital, service-oriented, competitive business faced with fluctuating markets, capital investment challenges, regulatory problems, and all the other difficulties and advantages of contemporary business, national and worldwide.

There is one constant, however. The men and women who operate today's scrap processing and recycling companies are the direct descendants, in every definition, of those early, pioneering entrepreneurs who more than a century ago saw the future.

## The Future of Scrap Recycling

In a world of increasing production and decreasing space for depositing our wastes, the necessity for workable policies and programs to enhance scrap recycling has in recent times become abundantly clear.

What, then, is holding us back? Why, for example, have we been unable to make use of a growing U.S. stockpile of more than 800 million tons of scrap iron and steel alone, not counting nonferrous metals, paper, glass, textiles, and plastics? There are a number of answers.

First, we must increase our markets for recycled goods. This elementary principle of economics and business is surprisingly ignored by some policymakers and planners. Even as communities across the United States organize local recycling programs, there is often times a failure to address the basic problem of finding a market for the materials collected. Little would be accomplished if citizens are required to separate their old newspapers, for example, from other trash and deposit the papers in neat stacks for curbside pickup. If the market for old newspapers cannot be increased, then the papers simply are sent to the nearest landfill or incinerator, and once again the opportunity for recycling is lost.

Although the use of recycled newsprint is increasing and more companies and organizations are using stationery and other paper products made from recycled fibers, the percentage of recovery and use is still small.

Newspapers, the largest users of pulp paper for newsprint, regularly editorialize on the need for finding solutions to our environmental problems, but the number of major publications in the United States that use recycled newsprint as a major part of their raw products is still far below the level of usage necessary to help stem paper waste.

Some containers — such as aluminum cans — are successfully recycled, but here again the need for a sustained market is a problem. Aluminum use has dropped and soared in recent years, with the value of the throwaway aluminum can at roadside following the price path. Used glass and steel containers have more limited markets, although progress is being made toward recycling more of these, too.

The waste of textiles in the United States alone is staggering, and the recycling of plastic materials is only beginning the long climb toward its potential. There is every evidence that a sweater made of recycled material is just as durable and just as attractive as one made of virgin fabric. But the marketplace favors the latter.

The existing scrap companies and organizations such as the Institute of Scrap Recycling Industries have long sought to educate both government officials and the public on the need for helping create new and incremental markets for recycled materials. There exists, however, a need for a clear policy at all levels of government and civic leadership that will enhance recycling by creating such markets — and also by avoiding unnecessary regulation and restriction on recycling.

Instead, some legislation — at federal, state, and local levels — is frequently counterproductive to recycling efforts, not taking into consideration the role of the existing scrap recycling industry.

A number of states have enacted or are considering solid waste legislation for county and municipal recycling programs. These can serve the public interest, but only if they make certain the existing scrap industry is not harmed or destroyed in the process.

A vivid example of well-intentioned regulatory activity that failed to achieve its purpose and instead injured environmental progress came in several states in early 1988 over the issue of scrap metal residue.

For as long as there have been washing machines, refrigerators, and stoves in the United States, there has been a scrap processing company to remove discarded appliances, turning them into processed scrap metal for resale to steel mills and foundries.

But when a number of scrap metal processors were ordered to treat the residue from processing these materials as a hazardous waste and told to dispose of it in extremely expensive special areas instead of the usual local landfills, processors said they could not do it economically and were forced to stop handling old appliances. The result was a vast pileup and backup of used appliances, causing great consternation for citizens, town councils, and scrap processors alike.

Such a situation could have been avoided if federal requirements on disposal of old appliances had been reasonably applied. Instead, the U.S. Environmental Protection Agency, which had ruled previously that pre-1979 appliances containing small capacitors could be buried whole in landfills, said those appliances could not be shredded with the residual "fluff" buried in the same landfill if the alleged contamination in the residue exceeded a certain standard. This occurred even though the capacitor containing the same amount of PCBs (polychlorinated biphenyls) could be disposed of in the same landfill.

An even more disastrous example of well-intended directives gone astray is the federal government's application of the Superfund environmental clean-up laws.

Instead of enhancing cleanups of the environment, the legislation threatens to put a number of scrap processors out of business simply because they shipped material for recycling to sites that, years ago, were used by previous owners for recycling activities that were appropriate then — but which today's environmental standards would not allow. Because the Superfund legislation contains no limit on liability, a scrap processor could be held accountable for activities that took place years before by another operator (and were legal and accepted at the time). As incredible as it sounds, a scrap processor today can be held responsible for cleaning up a battery recycling site that may have polluted its land 30 or more years ago using technology current at that time and despite the fact that the processor sent the material for recycling, not disposal.

Although Superfund's environmental objectives are laudable, the law's applications must be carefully examined to avoid forcing on the scrap industry financial responsibility requirements for costs that may well exceed the entire net worth of the industry.

Because of this threat, current recycling of many items becomes a serious problem for today's processor. What if today's standards are deemed inappropriate 10 years from now? Will Superfund then ask processors to pay for problems related back to today's recycling shipments? Many processors are not handling previously recyclable materials to avoid these calamitous potential liabilities.

In addition to revising laws that are or can be misapplied, government also can take the lead in developing initiatives to help create new markets for recycled goods. The new markets must be in addition to — not in lieu of — historic demand for recyclables; otherwise no true increase in recycling will be realized.

Scrap processors stand ready to participate and assist in expanded recycling. They ask only that government take effective steps to help develop and encourage the necessary markets; that government recognize and not jeopardize existing capability to process and market recyclables; and that commercial entities have a full and fair opportunity to perform recycling services for the public on a fair, competitive basis.

The future for recycling is limitless — in the United States and throughout the world.

Actually, we have little or no choice but to recycle. Otherwise, we will be inundated with our discards, and with those discarded materials will come staggering problems that threaten our health as a people, mar the beauty of our lands, deplete our natural resources, and injure our economic well-being.

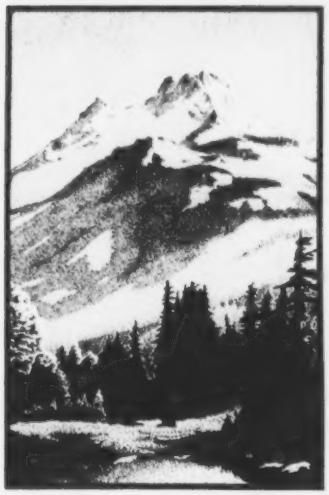
We cannot afford, then, not to recycle.

# Scrap Processors Recycle Today For A Better Tomorrow

Members of the Institute of Scrap Recycling Industries, Inc. (ISRI) are important contributors to the process of reclaiming obsolete items for reuse through recycling. They purchase scrap iron and steel, nonferrous metals, paper, textiles, plastics and glass. Using sophisticated techniques and equipment, they prepare these various kinds of scrap to rigid specifications for remanufacture into new products by industrial consumers.

ISRI members are processors, brokers and consumers of a wide variety of scrap commodities, all of which—as recycled goods—ensure that we conserve the materials from which these products were originally manufactured, as well as huge amounts of energy sources required to make them.

**Energy Savings Resulting From Scrap Processing & Recycling**



| | |
|---|---|
| 95% | Aluminum |
| 85% | Copper |
| 74% | Iron & Steel |
| 65% | Lead |
| 60% | Zinc |
| 64% | Paper |
| 30% | Glass |
| 80+% | Plastic |

ISRI members are professional scrap processors and recyclers committed to Conserving the Future by Recycling the Past!

**Institute of Scrap Recycling Industries, Inc.**

1627 K Street, N.W.
Washington, DC 20006-1704
Telephone (202) 466-4050



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**Institute of Scrap Recycling Industries, Inc.**

*1627 K. Street, N.W.*
*Washington, D.C. 20006-1704*
*(202) 466-4050*

## Recycling Nonferrous Scrap Metals

**Institute of Scrap Recycling Industries, Inc.**



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## What Are Nonferrous Scrap Metals?

Nonferrous* metals are those that contain little or no iron. They include aluminum; copper; lead; zinc; nickel; precious metals such as gold, silver and platinum; magnesium; as well as special metals such as titanium, cobalt, chromium and tungsten; and metal alloys, which are made of a combination of two or three metals, such as brass—made of copper and zinc, and bronze—a blend of copper, tin and zinc. When products made from these metals, such as aluminum beverage cans, copper wiring or automobile batteries, complete their useful life, they become scrap metal and can be recycled to manufacture new consumer products. Recycled nonferrous metals are an important raw material in supplying a major percentage of our metal consumption needs, while conserving natural resources such as virgin ores. In addition, the Environmental Protection Agency (EPA) has found that far less energy is required to manufacture products from recycled metals than from virgin materials.

**Percentage of U.S. Raw Material Needs Supplied by Commonly Recycled Nonferrous Metals**

| | |
|---|---|
| 43% | Copper |
| 32% | Aluminum |
| 55% | Lead |
| 19% | Zinc |

Nonferrous scrap is generated from two principal sources. *Industrial* or *new scrap* is a by-product of manufacturing processes. It has never been made into or used as an end product. Examples of industrial scrap are the aluminum skeleton that remains after can lids are punched out of aluminum sheets, or the brass skeleton formed after locks are manufactured, or copper scrap from tubing fabrication. *Obsolete scrap* is the discarded, dismantled, worn-out metallic element such as copper cable or copper or brass pipe taken from an old building. From the cable obviously comes copper, and from the pipe comes copper and zinc. Aluminum is recovered from used beverage cans and building siding, platinum from automobile catalytic converters, copper from electrical wiring, gold from computers, nickel from stainless steel appliances, and silver from spent photographic film.

* The root of this word, *ferrum*, is derived from the Latin word for iron.



## Why Is It Important to Recycle Nonferrous Scrap?

Like iron and steel (known as ferrous metals), nonferrous metals originate in mineral ores mined from the earth, but even the most plentiful are a nonrenewable resource. Recycling these metals gives us a virtually unlimited supply for future use because all of them can be remelted and fabricated into new products over and over again. They literally constitute mines above ground.

Besides conserving virgin minerals, when we recycle nonferrous metals to make new products we conserve billions of cubic feet of landfill space. We also greatly reduce the amount of energy required to manufacture them. Our estimated energy savings when we use four of the most commonly recycled nonferrous metals—aluminum, copper, lead and zinc—to make new products, rather than using virgin ores alone, provide compelling reasons why it is important that we increase the recovery, processing and reuse of nonferrous scrap.

**Estimated Energy Savings Achieved by Manufacturing Products with Nonferrous Scrap**

| | |
|---|---|
| Aluminum | 95% |
| Copper | 85% |
| Lead | 65% |
| Zinc | 60% |

## Aluminum: A Recycling Success

Today, the most widely recycled nonferrous metal is aluminum, but it was not always that way. The aluminum success story provides a model for the benefits that could be achieved in the U.S. through increased recycling of other metals.

In 1988, the U.S. consumed approximately 6.9 million tons of aluminum for all products. To meet that apparent consumption, the aluminum industry purchased nearly 2.5 million tons of obsolete and industrial scrap, resulting in a national recycled aluminum use rate of about 36 percent. In 1978, that rate was only 23 percent.

## Aluminum Used Beverage Cans

Recycled used beverage cans collected and melted in 1988 totaled 752,500 tons—resulting in an aluminum can recycling rate of 54.6 percent. The aluminum industry has targeted a 75 percent recovery rate by 1995.

The aluminum industry estimates that the 95 percent energy savings achieved through recycling conserves approximately 7.5 kilowatt hours of electricity for each pound of metal recycled. In 1988, that resulted in a total crude oil savings for the U.S. of almost 19 million barrels of oil. The energy saved from aluminum can recycling during that one year was enough to supply all the annual power needs of Boston.

In addition to saving energy, the estimated 272 billion cans reclaimed during the 1980s saved 2 billion cubic feet of landfill space, according to the aluminum can industry. Today, the industry estimates that 67,356 aluminum beverage cans are recycled *each minute*.

# How Does the Nonferrous Scrap Recycling Industry Work?

The nonferrous scrap recycling industry is complex and requires a work force highly knowledgeable in metallurgy, chemistry and engineering practices, as well as management skills and domestic and international trading. A brief outline of how the industry works, with a description of the interdependence of its various components to make true recycling occur, will correct notions that merely separating and collecting obsolete products at their source constitute recycling.



## Nonferrous Scrap Sources

The nonferrous recycling industry purchases its scrap from a wide variety of sources including industrial plants, government facilities, utility companies, farms, auto dismantlers, railroads, shipyards, airlines, building dismantlers, demolition operations and municipalities.

These sources sell their scrap to two possible outlets: scrap dealer/processors or metallic users or consumers.

## Scrap Dealer/Processors

Scrap dealer/processors purchase the scrap and begin a complicated process requiring identification of the metals, sorting by grade, preparation of the scrap for sale to users, packing and shipping.

The scrap dealer/processor must possess a thorough knowledge of metals to begin the identification process because several different metals, as well as alloys, could make up a single piece of scrap. The dealer/processor, through long years of experience and extensive training, frequently can identify the metallic components by sight, but may have to rely on testing, including the application of acid or other chemicals to ascertain the exact composition of the scrap. Occasionally, dealer/processors may even have to resort to more precise laboratory analysis and identification at their own plants or at outside laboratories where the scrap is examined through the use of x-ray fluorescent equipment, such as spectrometers and spectrographs.

Once the dealer/processor correctly identifies the scrap components, it is sorted into grades of metal. This is a very important step because the end consumer will require that the scrap be segregated according to rigid specifications before it can be melted into new metal products. The dealer/processor then prepares the scrap, using a variety of methods that might include shearing, cutting, chopping, shredding, melting or sweating.

Once processed, the scrap is packed for shipping. Depending on the kind of scrap and the requirements of the consumer who will be using it, the scrap might be packed in boxes, bales, bundles, drums or briquettes. Some scrap might even be shipped loose in trucks, railroad cars and ships.

At this point, the dealer/processor is ready to ship the scrap to an intermediate metallic scrap user, an end user or an export market. The scrap will be shipped by truck or possibly by rail. Exports are generally transported by ship in containers.

## Intermediate Metallic Scrap Users

Intermediate metallic scrap users are smelters or refiners who buy scrap from industrial generators or, more commonly, from scrap dealer/processors. Essentially they purchase this nonferrous scrap to melt and then to manufacture a product to a certain specification in a specific form. Products might include ingots (weighing approximately 30 pounds), billets, sows (800-1,000 pounds), notch bars (less than 10 pounds), molten metal (shipped in liquid form), shot (small metallic pellets) and wire bar (copper that goes into a wire drawing mill). To do this, the smelters and refiners employ crushers, dryers, furnaces and sophisticated laboratories to manufacture their products for shipment to foundries, die casters, wire mills or other direct end users or consumers.

Alloys created at this recycling stage are manufactured to strict chemical and physical specifications in order to be used to fabricate products such as the large five-bladed propellers that run supertankers and the small aluminum pistons that power high-speed sports cars.

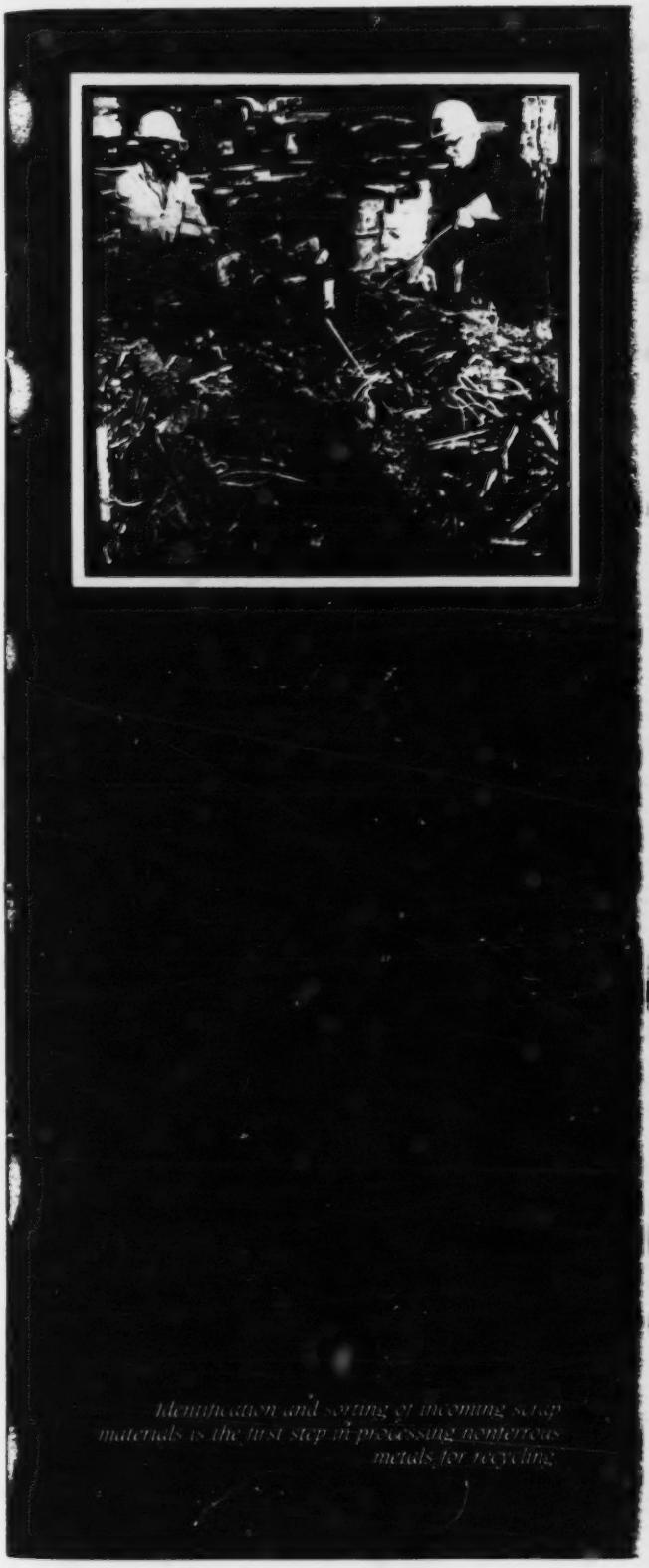
## End Users

End users or consumers purchase the scrap directly from dealer/processors or, as a semi-manufactured product, from intermediate metallic users.

They include foundries, die casters, mills, fabricators and manufacturers. End users employ heat, chemistry and alloying techniques to make metal suitable for the manufacture of metal products or semi-finished metal goods to be sold to factories making industrial and consumer goods. These are semi-finished products such as castings, which might be used ultimately as automobile castings. In this group are brass mills, tube mills, wire mills, aluminum mills, foundries and similar manufacturers.

## Export Markets

The tonnage involved in U.S. scrap exports is significant because there is far more supply than domestic and export demand, which means that, without exports, the recycling rate would fall and supply would increase. In addition, the export of scrap aids the U.S. in improving its balance of payments. Finally, scrap exports continue a long historical tradition involving the U.S. engagement in international trade.



*Identification and sorting of incoming scrap materials is the first step in processing nonferrous metals for recycling.*





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## The Raw Materials of Metallic Scrap Processing

ISRI members handle many of the 105 known chemical elements. In terms of tonnage, the most widely used metals are iron, aluminum, copper, zinc, lead and nickel. They are also the most widely recycled metals.

Many nonferrous scrap dealer/processors deal in a broad range of metals, including even ferrous metals, while others may specialize in particular metals or alloys, especially if a metal is a high-value material that requires exact analysis and separation.

The exotic metals and complex alloys containing nickel, chromium, cobalt, titanium, zirconium, tungsten, magnesium, manganese, molybdenum, columbium, tantalum, as well as the precious metals—gold, silver and the platinum group of metals—demand technological applications and preparation prior to recycling that are almost as complicated as the uses to which they are put in advanced technology, including aerospace and defense applications. The following metals constitute the raw materials of metallic scrap processing.

**Iron**—When carbon is added to iron, steel is formed. Through the centuries, other elements have been added to the iron and carbon mixture to produce a multitude of steel grades. Steel is the most widely used metal alloy in the world. It is present in transportation and construction products, all kinds of industrial equipment and machinery, and in appliances.

**Aluminum**—Aluminum is a comparatively new metal that has been produced in commercial quantities for less than 100 years, but is second only to iron in world consumption. It weighs about one-third as much as steel or copper, and because of its high strength-to-weight ratio, aluminum is ideally suited to aircraft, missiles, automobiles and trucks, and marine vessels. Primary sources of obsolete aluminum scrap are beverage cans, aircraft, automobiles, trucks, appliances, furniture and electric utilities.



**Copper**—This red metal is widely used for its electrical and thermal conductivity, its chemical stability and its workability. Brasses are copper alloys containing zinc as the principal alloying element. Bronzes are copper alloys in which the principal alloying elements are tin and zinc. Other classes are copper nickels, copper-nickel-zinc-alloys, and leaded coppers. Automobile radiators, telephone and utility wire and cable, tubing, electrical motors, generators, ammunition shell cases, plumbing fixtures and railroad equipment are major sources of obsolete red metals.

**Zinc**—One of the most important uses of zinc is as a protective coating (galvanizing) on steel. It is also widely used to make die castings for automobile and construction applications, as an alloying element with copper to make brass, and as a chemical compound in rubber and paints. Although the tonnage of zinc die casting used by the automotive industry has been steadily declining, the percentage of zinc die cast scrap recovered from shredded automobiles has increased to virtually 100 percent.

**Tin**—One of the earliest known metals to man, tin was used in bronze as early as 3500 B.C. Today, most tin is used as a protective coating (tin plate) for steel containers, in solders and other alloys—including chemicals—for widely diversified applications. The U.S. either imports or reclaims virtually 100 percent of its annual tin requirements. Tin is being recycled from tin plate and used container scrap, as well as from solder drosses.

**Lead**—The major use of lead is batteries for energy storage. It is also used in ammunition and electrical cable sheathing. Scrapped batteries account for the majority of recovered lead. As a percent of output, lead is the most recycled metal.

**Nickel**—Nickel is vital to the steel industry for use in alloys with other elements to add strength and corrosion resistance over a wide range of temperatures. The most common form of stainless steel contains 18 percent chromium and 8 percent nickel. Superalloys, which are usually nickel-based, contain more than 50 percent nickel, and are used, for example, in aircraft turbines requiring high temperature strength.

**Chromium**—This metal is used to produce stainless, tool and alloy steels and nonferrous alloys. Steel must contain at least 10 percent chromium to be considered stainless. The use of chromium enhances hardness and resistance to corrosion or oxidation.

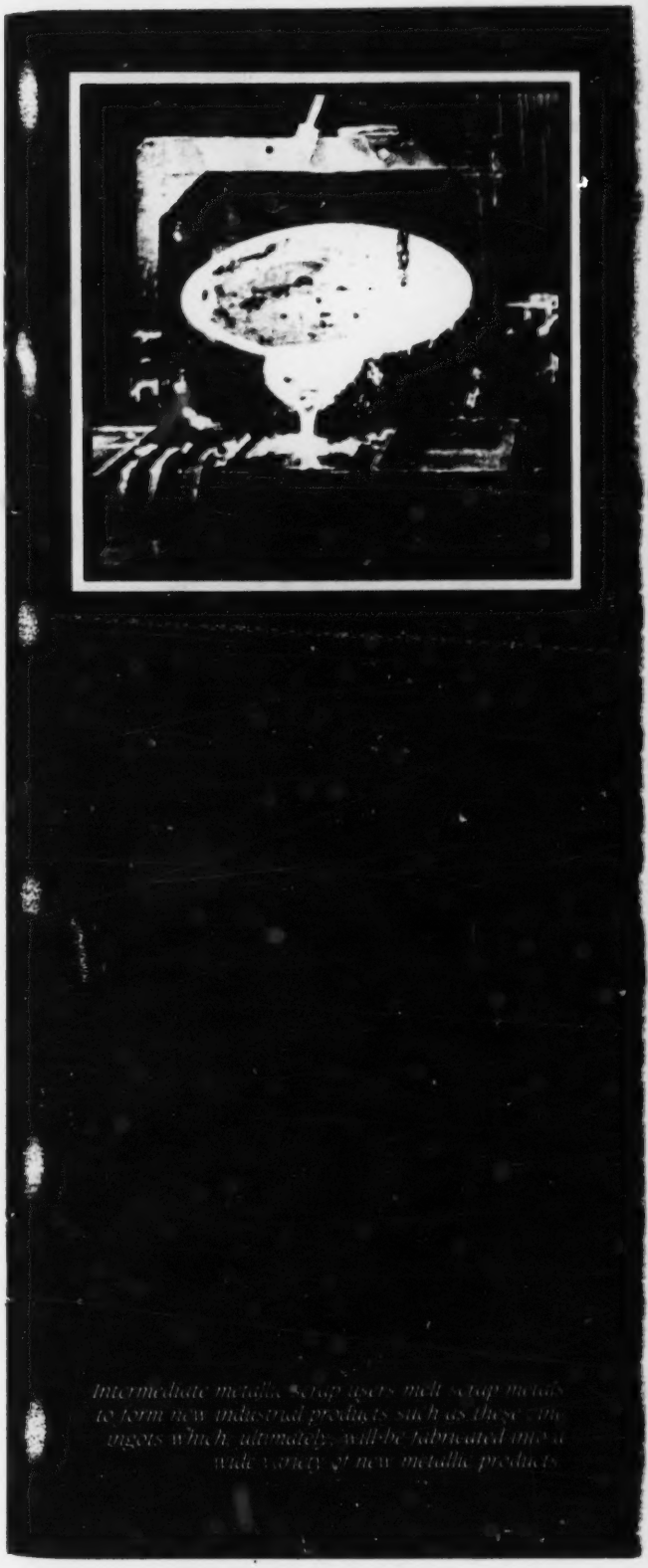
**Cobalt**—Cobalt is an essential element in many alloys and is vital in the aerospace and electrical product industries. Because of its heat resistance, high strength, wear resistance, and superior magnetic properties, it is used for cutting tools, jet engine parts, electrical devices, permanent magnets and catalysts.

**Molybdenum**—This is used in stainless and alloy steels, in high-strength, low-alloy steels, and in tool and high speed steels. "Moly," as it is called in the trade, improves hardenability and toughness, resists abrasion and corrosion, and enhances hardness and strength, particularly at high temperatures.

**Tungsten**—Tungsten maintains its hardness even at extremely high temperatures. It is used in high speed tools, and die steels, superalloys and nonferrous alloys. The chief nonindustrial use of tungsten is in armor piercing ordnance. Alloyed with copper or silver, it is used for electrical contacts providing wear resistance with adequate electrical conductivity.

**Magnesium**—Magnesium is used as an alloy with other metals such as aluminum, and as a reducing agent for metals such as titanium, zirconium and uranium. It is used in aircraft, automotive, and other types of transportation and material-handling equipment.

**Manganese**—Manganese is essential to produce steel and to control oxygen and sulfur that make steel workable. It also improves strength, toughness and hardenability. It is a common constituent in a number of other metals. It is present in all cast iron as well as steel, and in many varieties of brass, aluminum bronze, and in aluminum- and nickel-base alloys.



*Intermediate metallic shop layers melt scrap metals to form new industrial products such as these ingots which, ultimately, will be fabricated into a wide variety of new metallic products.*



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**Titanium**—The space industry consumes the majority of titanium. It is also used for pipe and tubing for surface condensers in power plants, for heat exchangers in the chemical industry, for water desalination evaporators, and as plate, pipe and tubing for chemical process equipment.

**Zirconium**—A primary application of zirconium is its use in commercial water-cooled reactors for fuel cladding and pressure tubes. It is also used in corrosion-resistant applications in the chemical industry.

**Columbium**—Columbium is used as an alloy in high-strength, low-alloy steels and superalloys. It is used in pipeline and tubular steels, in titanium base alloys for deep sea submersibles, in various superconductor materials, and in aircraft fasteners.

**Tantalum**—Capacitators for computers and automotive and military applications are made with tantalum.

**Gold**—In addition to its importance as a monetary base, and in jewelry, gold is critical to industry. Complex electronic circuitry, including that used in computers, requires gold. Gold, as well as high-performance gold-brazing alloys, are used to bond turbine blades in jet aircraft engines to their rotors.

**Silver**—The largest domestic use of silver is in the production of photographic materials. It provides high electrical conductivity (higher than copper), resistance to oxidation, and strength at a wide range of temperatures. As a result, it is often used as a contact metal in switches.

**Platinum**—Platinum is one of six closely related metals referred to as the platinum group. They are platinum, palladium, rhodium, iridium, ruthenium, and osmium. Scarce and expensive, they were used primarily for jewelry until the last three or four decades. Usually they perform one of two functions, serving as catalysts in the chemical, petroleum, refining, and automotive industries (catalytic converter), or serving as corrosion-resistant materials in the chemical, electrical, glass and dental-medical industries.



## Additional Information

For additional information on scrap processing and recycling, send this coupon, together with a self addressed business-size envelope, to: Public Relations Dept., Institute of Scrap Recycling Industries, Inc., Suite 700, 1627 K Street, N.W., Washington, DC 20006-1704; telephone: (202) 466-4050.

Place an X next to each ISRI publication you would like to receive.

___ Recycling Scrap Iron and Steel

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# ISRI

*Conserving the Future by Recycling the Past*

## What is ISRI?

ISRI—the Institute of Scrap Recycling Industries, Inc.—is the trade association of the scrap processing and recycling industry. It represents over 1,800 companies which process, broker and consume scrap commodities, including ferrous and nonferrous metals; paper; glass; plastics; and textiles. Suppliers of equipment and services to this industry complete ISRI's membership.

Many ISRI member companies are family-owned businesses, some of them in continuous operation for over 100 years. Other members are large publicly-traded or privately held corporations. All are experts in the handling, processing, shipping and/or ultimate recycling of scrap commodities and can assist communities and organizations in the planning, establishment and implementation of recycling activities. Because they are experts in resource recovery, their experience and handling capabilities can save countless public and private hours and dollars in developing effective approaches to resource recovery.

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*Cover photo: Aluminum beverage cans are tightly packed into bales and shipped to smelters to be recycled into new aluminum industrial products.*

*Printed on Recycled Paper*

**Institute of Scrap Recycling Industries, Inc.**

*1627 K. Street, N.W.*
*Washington, D.C. 20006-1704*
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## Recycling Paper

Paper Stock Institute

A Division of the

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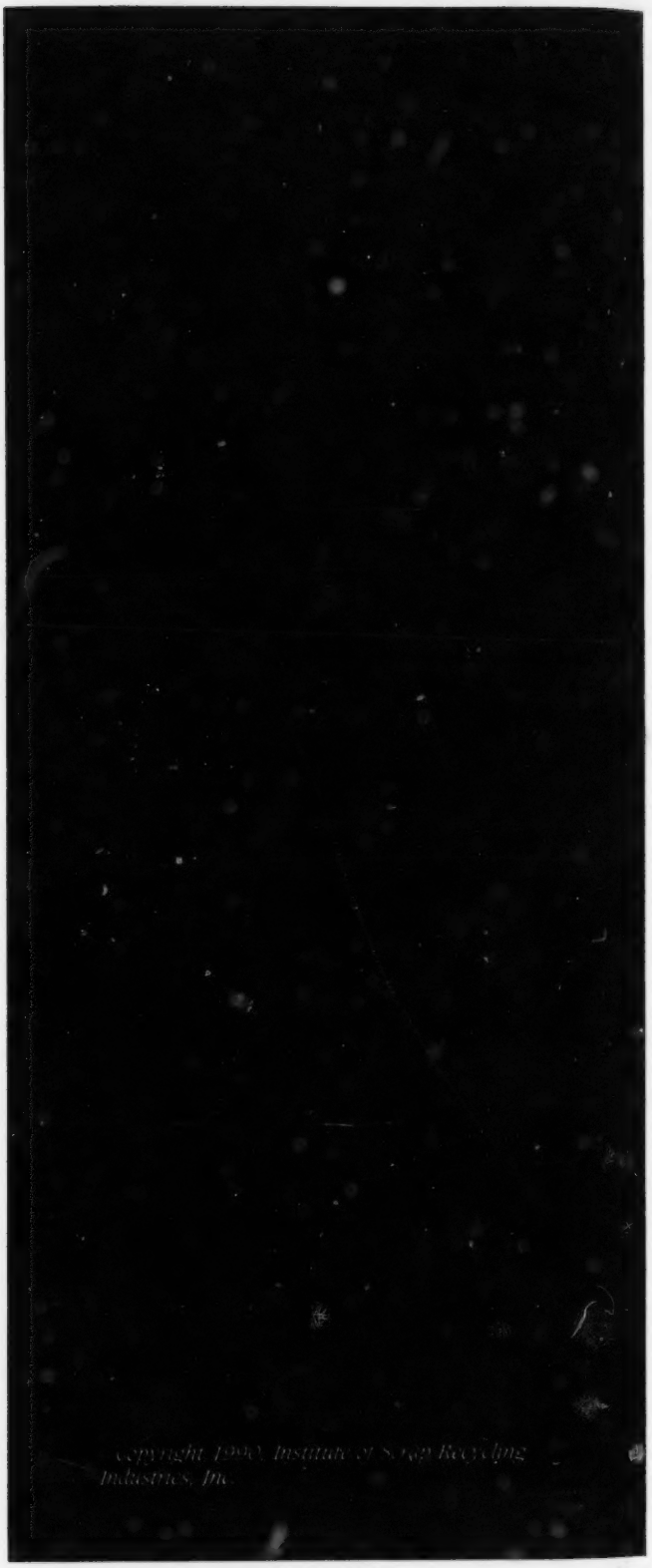


## Why Recycle Paper?

Currently, over 40 percent of all U.S. municipal solid waste consists of paper and paperboard products. Most of this used or scrap paper is discarded in landfills or incinerators, creating cost and environmental problems although, if salvaged and recycled, it could be used to help avoid waste management problems, reduce trade deficits and provide benefits to the environment. This is what a commitment to recycling scrap paper products can do, but we need to expand this commitment. The U.S. annually uses over 75 million tons of paper and paperboard—about 600 pounds per person—and we currently recycle about 20 million tons.

The Environmental Protection Agency (EPA) has identified important benefits of paper recycling: environmental protection and conservation, as well as reduction of solid waste. The Paper Stock Institute would add another: economic savings and even a return to communities, businesses, organizations and nations which commit themselves to using more recycled paper products rather than coping with the high disposal costs of solid waste.

## Environmental Benefits

Making new paper products from scrap paper results in significant energy savings and water use. For example, according to EPA, every ton of recycled paper produced requires 7,000 fewer gallons of water to manufacture than virgin paper. Each ton of recycled paper produced requires approximately 4,100 kwh less energy than virgin paper production. Furthermore, manufacturing with scrap paper results in lower levels of harmful emissions into the environment compared to the pollution that results from virgin wood pulp paper manufacture. Specifically, the EPA has found that making paper from recycled materials results in 74 percent less air pollution and 35 percent less water pollution. This means that every ton of recycled paper keeps almost 60 pounds of air pollutants out of the atmosphere that would have been produced if the paper had been manufactured from virgin resources.

Recycling paper also helps to conserve our forests. Despite improved tree-growing and harvesting techniques, the use of wood pulp from trees cannot be depended on to meet the long-term paper needs of the U.S. or even the world economy.

## Waste Prevention

Clearly, when scrap paper is recycled, communities do not face that volume of materials that otherwise must be disposed of, usually through landfill dumping or incineration. Through careful separation, particularly at the source, scrap paper can be successfully salvaged and reused. At a time when landfill sites are rapidly disappearing, each ton of waste paper separated from municipal solid waste saves more than 3 cubic yards of landfill space.

## Economic Incentives

Whenever we can save scrap paper from disposal, we save companies and communities significant tax dollars in disposal costs, including tipping or dumping fees at landfills, which are as high as $100 a ton and more in some regions. When governments commit themselves to purchasing products made from recycled paper, they frequently can buy such products at the same or lower cost than the virgin-based alternative while helping to stimulate markets for recycled items that otherwise would have created disposal problems for them. Unlike disposal, paper recycling is a revenue-generating activity. Paper stock dealer/processors maintain extensive tax paying operations—often valued in millions of dollars—while employing thousands of people throughout the nation.

Scrap paper exports also contribute significantly to the national economy and are a positive factor in our international trade position. In recent years, total paper stock exports averaging over $500 million annually have helped to reduce our national deficit in trade with foreign nations. Leading foreign purchasers of scrap paper include Korea, Mexico, Taiwan, Japan, Canada, Italy, Spain and Venezuela.



## What Is a Scrap Paper Dealer/Processor?

In order to be recycled, scrap paper and paperboard, or paper stock, as it is called by the industry, must be recovered, sorted into grades, processed to rigid specifications, packaged and shipped to mills for manufacture into new paper. Scrap paper dealer/processors perform all of these important tasks. They purchase the scrap paper materials from industrial, commercial, residential and institutional sources and professionally prepare them for reuse by mills.

Because scrap paper must be classified by grade before it can be recycled, an important activity of the Paper Stock Institute is the development of paper stock specifications. A paper stock dealer/ processor must be a technical expert, for PSI lists over 50 different grades of scrap paper in its specifications circular. Scrap paper classifications most familiar to the public are corrugated materials, old newspaper, mixed papers and high grade office waste papers.

## Corrugated Materials

Corrugated materials (commonly referred to as "cardboard") are the largest source of scrap paper collected for recycling. Paper boxes are used to ship merchandise such as stereos, TVs, canned food items and thousands of other consumer products to retail stores, supermarkets and factories. These sturdy boxes contain the corrugated waffle-like "medium" or center fluted element, which often is made of 100 percent recycled material. After their contents are removed, corrugated boxes are baled and shipped for recycling. In 1988, the U.S. recycled almost 10 million tons of corrugated boxes, about 50 percent of the corrugated boxes manufactured.

## Old Newspapers

Old newspapers are the primary grade of scrap paper collected from households. Because of increased public education about the benefits of recycling, public cooperation in old newspaper collection has been increasing steadily in recent years. Currently, about 35 percent of all used newspaper is recovered for recycling. In 1988, Americans consumed 13.2 million tons of newspapers and recycled 4.7 million tons.

## Mixed Papers

Mixed papers are precisely what their term implies: a variety of paper types that are collected from offices, industrial plants, schools and other paper consumption locations. Paper stock dealer/processors must concentrate on removing nonfibrous contaminants from the mixture, including cans, glass, plastics and waxes.

## High Grade Office Scrap Papers

With a growing appreciation of the benefits of recycling has come an increasing understanding that different scrap papers have different values for recycling. As a result, many offices, schools and other organizations with high volume paper use are beginning to separate high grade scrap papers from other used office mixed paper. In this category would be tabulating cards (key punch), computer printout papers, copy machine papers, as well as white stationery. Frequently, individual employees separate this scrap paper in bins or racks at their desks or in the computer areas.

# Scrap Paper Processing Equipment

Scrap paper dealer/processors make a significant capital investment in their plants. They must purchase trucks to collect the paper. They use conveyors and forklifts to move the paper around the plant during processing, then compress it into bales for shipment. Some processors also use shredders, as well as a variety of large shears to cut up thick paper products such as books and manuals so that they can be recycled. Processors generally ship their recyclable paper by truck or rail, relying on sea transportation for exporting.

*Scrap paper processing plants bale paper to ship to mills for recycling.*





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## Products Made from Recycled Paper

Every day we use a wide variety of products made from recycled paper, but to reduce our waste volume, we must consciously determine to use more of them and to demand that manufacturers make more products containing recycled paper fibers available to us. Typical products made from recycled paper are:

**Corrugated Goods**—Once the old corrugated box used to bring us our toasters, microwave ovens and personal computers is emptied, it frequently lives again by being recycled into new corrugated boxes or other recycled paper products.

**Newspapers**—Old newspapers are used again to make new newsprint, as well as other products. In 1988, of the 13.2 million tons of newsprint used in the U.S., 1.4 million tons went back into the manufacture of new newspaper.

**Printing and Writing Papers**—Fine stationery; copying, ledger and other office paper; magazines, books and brochures; decorative and wrapping papers all contain recycled fibers in varying amounts. In recent years, a growing selection of attractive, high quality printing and letterhead papers has become available, many offering a recycled content of 50 to 100 percent. Even coated paper stocks that retain the impact of four-color graphics are now available with high recycled fiber content for magazine production.

**Tissues and Towels**—Approximately 5 million tons of tissue grades, consisting of toilet and facial tissue, paper napkins, towels, diapers and various other sanitary products are produced in the U.S. annually. About 2.5 million tons of waste paper are used to manufacture these products. According to the American Paper Institute, paper mills rely heavily on high grade scrap paper generated in manufacturing and converting operations to make these products. Increased separation of high grade office scrap paper could enable this type of scrap paper to be used for this purpose in the future. Lower grades, such as old newspapers and corrugated boxes, are being used to make some paper hand towels and industrial wipes.



**Combination Boxboard**—Cereal and soap boxes, shoe boxes, tissue boxes, beer and soft drink carriers—these are all familiar consumer products made with a heavy recycled fiber content, usually as high as 90 to 100 percent. That familiar inner liner of gray-colored board is putting old newspapers, along with other scrap paper, to work for us again.

**Construction Products**—Insulation, gypsum wallboard, roofing paper, flooring, padding and sound-absorbing materials all use recycled scrap paper, yet most consumers are unaware of these market applications. Almost a million tons of scrap paper are used annually as raw material for these products, but just think how much more paper could be reused if all government construction would use building materials made with a high recycled paper content.

**Kraft Paper**—We use kraft paper every day when we ask supermarkets to pack our groceries in brown paper bags. We also make significant use of kraft paper in shipping sacks that package bulk products such as agricultural seeds, animal feeds, fertilizers and cement, and in mail wrappings for magazines and catalogues.

**Molded Products**—Paper egg cartons, fruit trays, flower pots, as well as some industrial and construction products are made from scrap paper that is repulped and molded into this special-use packaging.

**Developmental Applications**—We are finding new uses for recyclable paper every day including a shredded bedding material for animals. Research is being conducted to make a pellet from old newspapers to be burned as a new energy source developed from this plentiful resource.

## Markets Essential to Increase Paper Recycling

Without consumers to make use of scrap paper, recycling cannot take place. Consequently, if we want to increase paper recycling, markets must be maintained and expanded for products that make use of recycled fibers. All governments—at a minimum—should follow EPA federal agency guidelines and recommendations on increased purchase and use of such products. Major corporations; educational institutions such as colleges and universities, as well as public and private school boards; and many medium and even small-size businesses should actively plan to make their scrap paper available for recycling and then to buy products made from recycled materials.

## Commodity Markets

Scrap paper is a commodity. Like all other commodities, prices are subject to fluctuations—upward and downward—due to a variety of factors. The most crucial components affecting price are supply and demand.

## The Private Paper Processor Can Help

As municipalities see the need to control solid waste volume, too often they rush to establish publicly-funded recovery systems without recognizing the private waste paper recovery industry that has existed in the U.S. for 300 years. In fact, from 1690 to the mid-nineteenth century, the American paper industry relied exclusively on recycled textile fiber to manufacture new paper. It was only with increased demand for paper products that paper producers had to develop new techniques that could use wood fiber as a supplement to the recycled fiber for paper-making.

Members of the Paper Stock Institute possess the technical expertise; long-term experience in collection, separation and processing; equipment and manpower capability; as well as the market and trading know-how—both domestic and international—to contribute to the success of municipal paper recycling programs. It makes little sense for communities to duplicate these professional services, usually at far greater cost to the community and its taxpayers, when an industry stands ready to help. PSI members can provide government and private business planners with guidance to develop economically sound and environmentally responsible recovery programs.

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## What Is the Paper Stock Institute?

The Paper Stock Institute, or PSI, is a division of the Institute of Scrap Recycling Industries, Inc. (ISRI). Founded in 1913, PSI is the national trade organization of companies specializing in scrap paper processing. It provides information to the government, industry and communities throughout the nation on the capabilities of recycled fibers and their role in helping to prevent solid waste problems. The Institute works to expand the recyclability of all types of scrap paper.

## What Is the Institute of Scrap Recycling Industries?

The Institute of Scrap Recycling Industries, Inc. (ISRI) is the trade association of the scrap processing and recycling industry. ISRI represents over 1,800 companies which process, broker and consume scrap commodities—including metals, paper, glass, plastics and textiles. Suppliers of equipment and services to this industry complete ISRI's membership.

Many ISRI member companies are family-owned businesses, some in continuous operation for 100 years or more, while others are large publicly-traded or privately held corporations. All are experts in the handling, processing, shipping and/or ultimate recycling of scrap commodities and can assist communities and organizations in the planning, establishment and implementation of recycling activities. Because they are experts in resource recovery, their experience and handling capabilities can save countless public and private hours and dollars in developing effective approaches to resource recovery.



## Additional Information

For additional information on scrap processing and recycling, send this coupon, together with a self addressed business-size envelope, to: Public Relations Dept., Institute of Scrap Recycling Industries, Inc., Suite 700, 1627 K Street, N.W., Washington, DC 20006-1704; telephone: (202) 466-4050.

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# ISRI

*Conserving the Future by Recycling the Past*

*Cover photo: Corrugated materials, or cardboard, are the largest source of scrap paper collected for recycling.*

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## Recycling Scrap Iron and Steel

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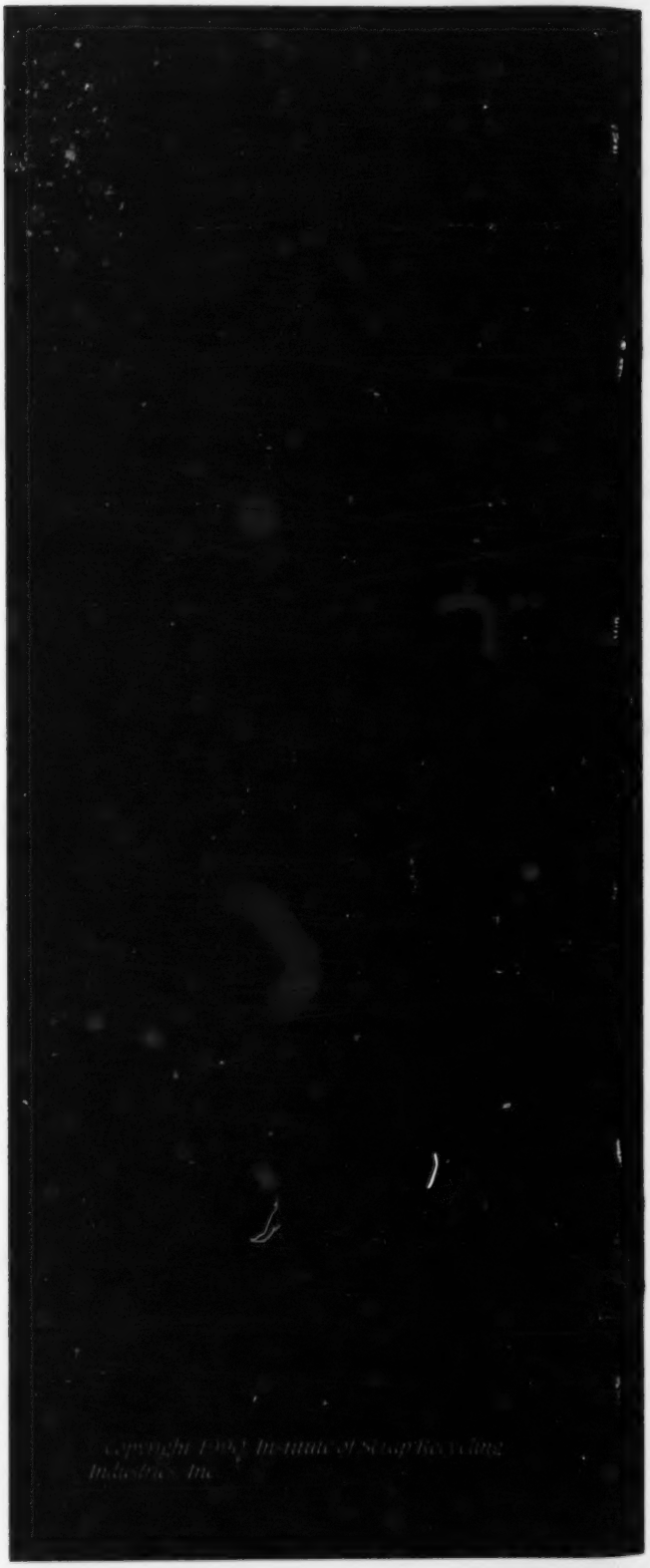

## Scrap Iron and Steel—The Ferrous Metals

When items such as old automobiles; household appliances; farm, office and industrial equipment; ships and railroad cars; buildings and bridges complete their useful life, they take on new value as an important manufacturing material known as scrap metal or, specifically, *ferrous** scrap. Iron and steel can be processed and remelted repeatedly for the manufacture of an almost unlimited number of new objects for use by industry and individual consumers alike. Ferrous scrap resulting from these sources is known as *obsolete* or *old scrap* and might come from a wrecking ball, shipyard, car dealer or even your own house.

Another type of ferrous scrap, *industrial scrap*—also called *new* or *prompt scrap*—is generated in manufacturers' plants and includes such items as stampings left over when an appliance part is made during manufacturing processes or when a hole is drilled for an automobile.

Finally, a third type, *home scrap*, results when steel mills and foundries manufacture new steel products. Home scrap rarely leaves the plant. Instead, it is returned to the furnace on site and melted again.

## The Scrap Iron and Steel Dealer/Processor and the Scope of the Ferrous Scrap Industry

Markets exist for all kinds of ferrous scrap, but in order to be recycled for new uses, scrap iron and steel must be specially prepared by a scrap dealer/processor who operates from a plant, preparing the scrap into grades to meet the rigid specifications required by the steel industry to make new steel. Scrap processing and recycling is an expensive and complex business requiring a major investment in heavy equipment, buildings and land, plus strong management skills and a thorough knowledge of metals. The scrap industry is composed of three important levels of expertise. *Dealer/processors* buy the scrap from a variety of sources including industrial plants, government facilities, farms, auto dismantlers, railroads, shipyards, building dismantlers, demolition operations, and municipalities.

* The word ferrous is derived from the Latin word *ferrum*, meaning iron.

At their plants and facilities, they prepare it for reuse, employing a variety of techniques, such as torching, cutting, baling and shredding. *Brokers* are the intermediaries between the dealer/processors and the consumers or users of scrap. They assist the dealer/processors in locating markets for their prepared scrap and help the consumers find a supply of the ferrous scrap products they need to run their manufacturing operations. The consumers are the mills and foundries that purchase the processed scrap, remelt it and manufacture a new steel product from it. The scrap consumer closes the recycling circle and actually enables recycling to occur since the steel is now being returned to the marketplace.

Operating at full capability, the U.S. scrap industry has the capacity to process 140 million tons of iron and steel materials annually. Even on a single shift basis, the industry can shred, shear, bale, crush, briquette, break and torch 70 million tons of scrap a year. The 5,000 units of high-volume production equipment capable of processing that 140 million tons represents a tremendous potential when you consider that domestic and foreign steel mills purchased only about 60 million tons of ferrous scrap in each recent year.

This huge processing capacity underscores the unused ability available to take advantage of the great economic and environmental benefits that steel recycling offers. Steel made from scrap is chemically and metallurgically equivalent to steel manufactured from virgin iron ore. In fact, more than half of all steel manufactured in the U.S. today is made of recycled material.

*Shredders are huge car eating machines that break an automobile into fist sized pieces of scrap in less than a minute*



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## Why Is the Scrap Iron and Steel Industry Important?

Everyone benefits from the reuse of iron and steel. The Environmental Protection Agency has identified seven major benefits when scrap iron and steel are used instead of virgin materials—that is, iron ore and coal—in making new steel.

**Benefits of Using Iron and Steel Instead of Virgin Ore to Make New Steel**

| | |
|---|---|
| 74% | Savings in energy |
| 90% | Savings in virgin materials use |
| 86% | Reduction in air pollution |
| 40% | Reduction in water use |
| 76% | Reduction in water pollution |
| 97% | Reduction in mining wastes |
| 105% | Reduction in consumer waste generated |

Recycled steel's energy savings alone have an enormous positive impact on the environment. Just think: it takes **four times** as much energy to make steel from virgin iron ore as it takes to make the same steel from scrap.

Recycled steel also helps control the volume of our waste stream. Currently, recycled steel saves the U.S. over $2 billion per year in avoided solid waste disposal costs at present average landfill tipping fee rates. Furthermore, steel recycling dramatically extends the useful life of landfills throughout the country. In the last decade, steel recycling has extended the life of the nation's landfills by more than four years. As we worry about disappearing landfill space, it is encouraging to note that the amount of steel recycled annually equals approximately one-third of the amount of all municipal solid waste landfilled throughout the nation each year.

Every year members of the Institute of Scrap Recycling Industries, Inc. (ISRI) prepare approximately 9 million old automobiles for recycling. Imagine what America might look like if these cars and the millions of old appliances and other obsolete objects we no longer want were not processed for reuse. If the scrap processing and recycling industry did not exist—and had not expanded to keep pace with the increase in manufacturing and subsequent obsolescence of these manufactured products—our streets and highways could be jammed with abandoned automobile, truck and mobile home carcasses; our factory doors could be all but impassable because of the mounds of unwanted materials; and our supply of landfills could be nonexistent because those dumping sites long ago would have reached their capacity and been closed forever.

By processing 60 million tons of scrap iron and steel a year, the scrap industry is conserving the nonrenewable supply of iron ore and coal in the earth. Scrap iron and steel literally constitute mines above ground, allowing scrap processors and consumers to conserve the future by recycling the past.

Steel scrap exports add another important aspect to the recycling picture. The tonnage involved in U.S. ferrous scrap exports is significant for a number of reasons. There is far more supply than domestic and export demand, which means that, without exports, the recycling rate would fall and supply would increase. Another major benefit is that scrap exporting aids the United States in improving its balance of payments. And finally, scrap exports continue a long historical tradition involving the U.S. engagement in international trade.

## Equipment and Processing Activities of the Ferrous Scrap Industry

A scrap iron and steel processing plant is a factory without a roof equipped with machinery capable of producing a valuable manufactured product for sale—graded scrap. The crane is the most widely used equipment in the industry, and almost every scrap plant has at least one, either the traditional cable model or the newer hydraulic cranes available on crawler, truck, pedestal, gantry, rail and overhead mountings. A crane represents a major capital investment ranging between $100,000 and $750,000.

Essential to the processing of ferrous scrap are electromagnets attached to the cranes. They range in size from 30 to 100 inches in diameter and weigh up to 12 tons. A magnet can cost more than $65,000. A 69-inch magnet, costing approximately $30,000, is the most common size used by scrap processors. It can lift more than 4,000 pounds of steel scrap.

### Baling Press

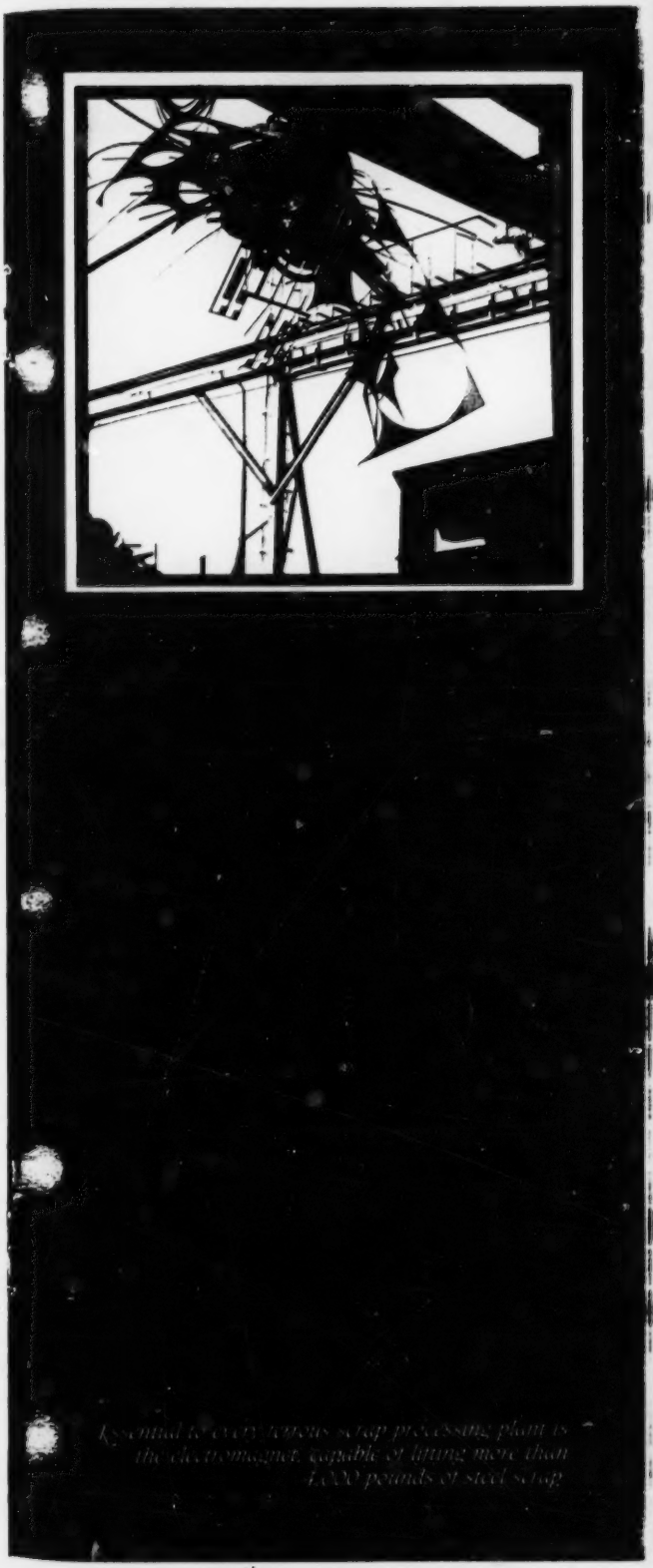
The hydraulic baling press of "Goldfinger" fame is equally prevalent as a major piece of processing equipment. It is used to compress metals that require greater density before remelting. Large balers are double- and triple-stroke compression units with a price range from over $125,000 to $3 million.

With 600 horsepower, the largest baling press can take three flattened autos without engines and in less than two minutes produce a 5,400-pound bale that is 36 inches by 24 inches by 60 inches. At 100 percent efficiency, this machine will process just over 40 tons of scrap per hour.

### Guillotine Shear

The hydraulic guillotine shear slices heavy pieces of steel including I-beams, ship plate, pipe and railroad-car sides much the way a knife cuts through a loaf of bread. Shears vary in size from 300 to more than 2,000 tons of head force. The shear knife, made of a chrome-nickel-molybdenum alloy steel for hardness, has cutting edges on four sides and is rotated as the blade gets dull.

Shear costs, including installation, range from over $300,000 to $4 million. A shear blade can be sharpened for about $2,500. After this has been done twice, the blade must be replaced at a cost of approximately $5,000.



*Essential to every ferrous scrap processing plant is the electromagnet, capable of lifting more than 4,000 pounds of steel scrap.*





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## Shredder

The industry giant in terms of size, output and cost is the shredder or fragmentizer, which can turn an old automobile into fist-sized pieces of scrap in less than a minute. A small shredder costs just over $1 million; a large unit can run well over $5 million. This represents only the initial cost. A medium-size shredder uses 36 hammers, weighing 250 pounds each, to pound auto hulks to pieces. After demolishing 6,000 cars, all the hammers must be replaced, at a cost of almost $20,000. Replacement costs of other parts could exceed $100,000 a year.

Although the predominant raw material for the shredder is automobile hulks, "white goods" (household appliances such as stoves, washers, dryers and refrigerators) and sheet steel are also shredded.

Approximately 200 shredders are currently installed in the U.S. Depending on its size, this car-eating machine can process from 1,500 to more than 20,000 tons of scrap a month.

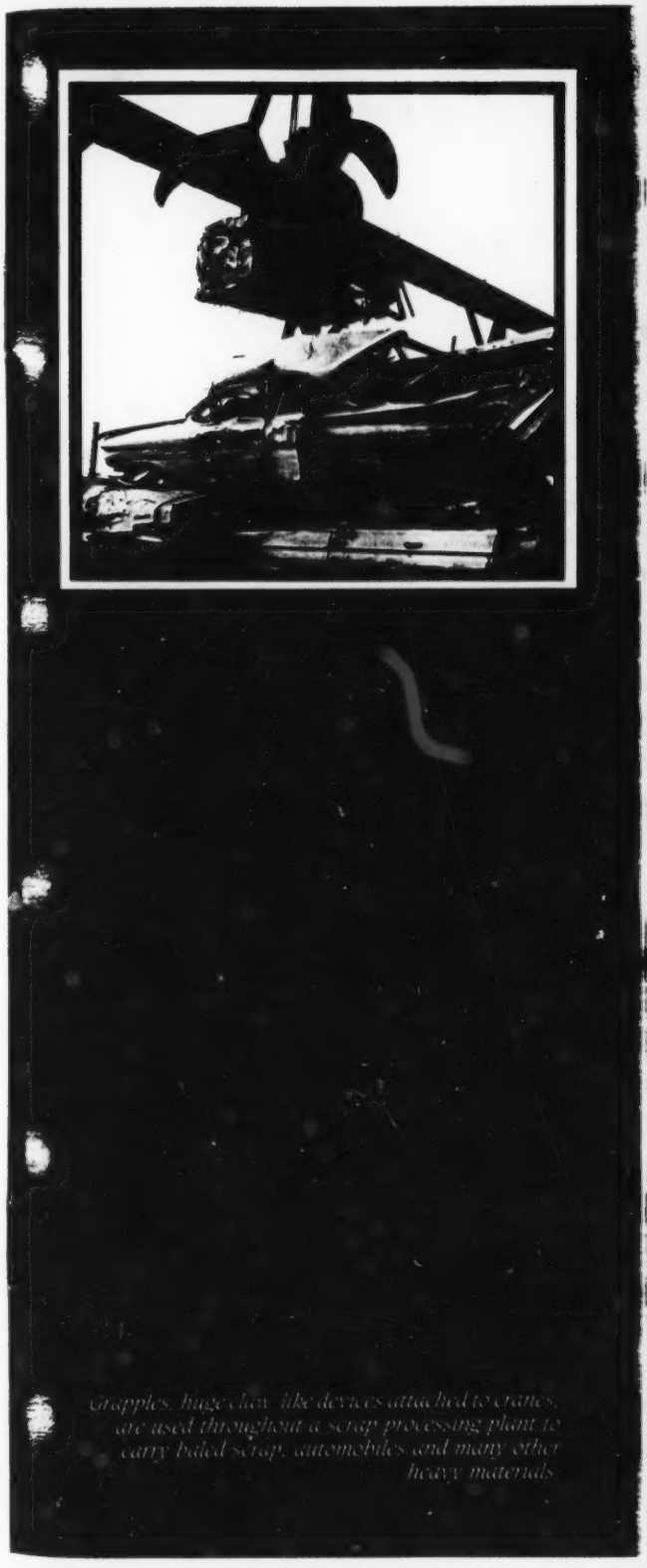
## Other Processing Equipment

Other equipment found in scrap processing plants might include scales, turnings crushers, and briquetters to shape small steel scrap pieces into forms more readily melted by mills and foundries, and motor block crushers.

But a significant investment must be made in equipment to keep the scrap moving from its originator, through the processing operation and on to the consumer. So most scrap plants also will have conveyors, truck fleets and containers ready to transport the processed metal by highway, rail or sea.

# Are Products Made from Virgin Iron Ore and Scrap Iron and Steel Comparable?

Ferrous scrap has been universally recognized for centuries as a highly desirable manufactured product. After the scrap dealer/processor prepares it to specification, it can be used repeatedly and successfully to manufacture parts for national defense and aerospace equipment, consumer products such as automobiles and appliances, and the more mundane applications in construction and mining. Thus, the same ferrous metal products can be manufactured from virgin iron ore, or recycled scrap iron and steel, or a combination of both, and provide identical performance.



*Grapples, huge claw-like devices attached to cranes, are used throughout a scrap processing plant to carry baled scrap, automobiles and many other heavy materials.*





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## Manufacturing Barriers to Steel Recycling

Despite the economic and environmental advantages derived from recycling steel, scrap dealer/processors are finding it increasingly challenging to handle many steel items because they are manufactured with hazardous components that make recycling either extremely difficult or, in some instances, even impossible.

To ensure the increase, rather than the demise, of recycling, the Institute of Scrap Recycling Industries introduced the concept of **design for recycling**. Manufacturers should plan for the eventual recycling of every product they develop and design them so that all products can be efficiently and safely recycled. Where this is not possible, manufacturers, who should be responsible for the proper handling of hazardous components in their products, should develop practical and efficient systems to do so.

## What Is ISRI?

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## Additional Information

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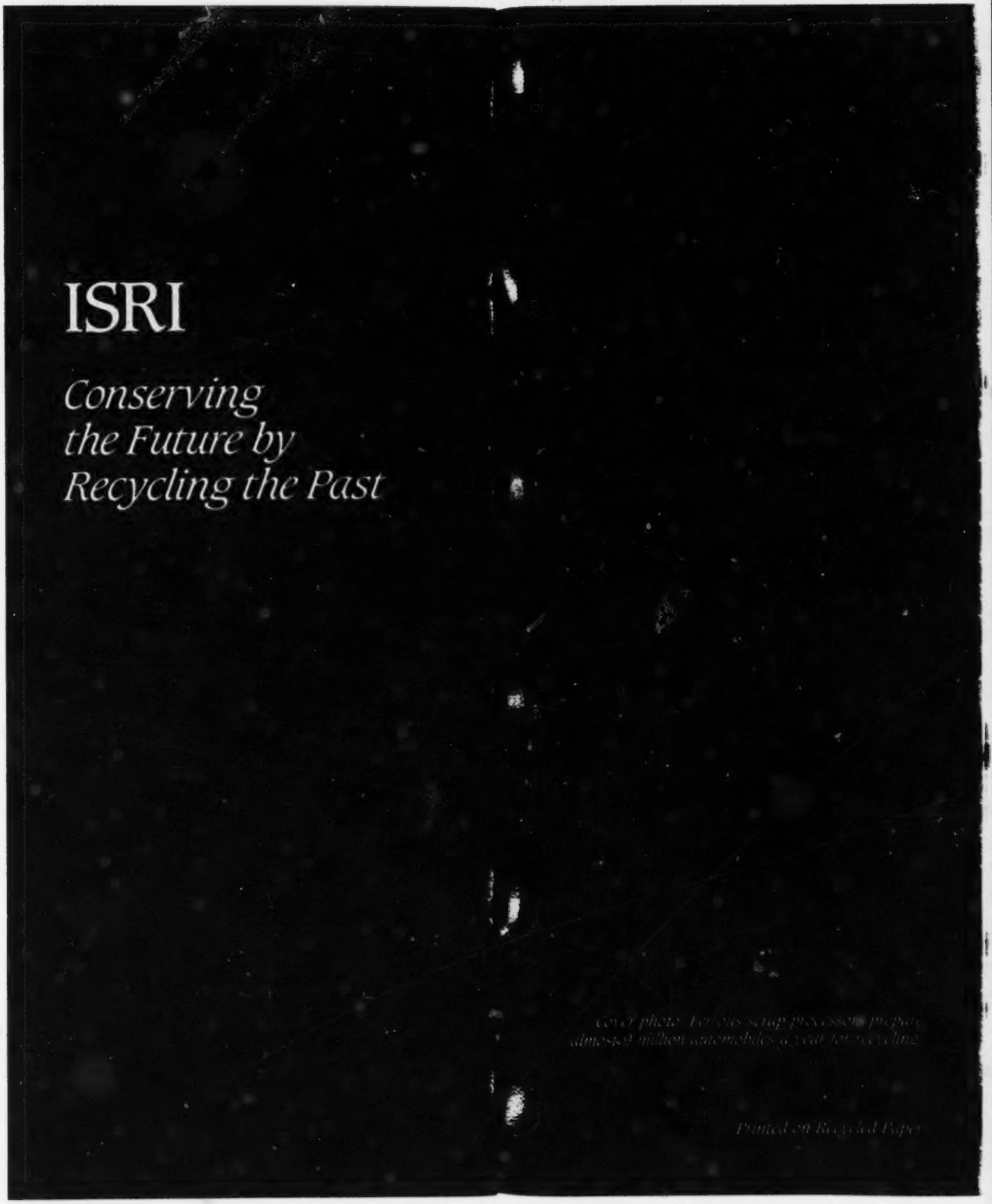
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